Make Your Pictures Sing!

HOW TO PERFECT
YOUR TECHNIQUE

PAUL LOUIS HEXTER, A.R.P.S.

"Alexander Woollcott" *Paul Louis Hexter, A.R.P.S.*

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By

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To my wife, who for five years was undoubtedly the most photographed woman in the world. Most of the pictures were never seen by her.

I also want to thank Baron Mario Bucovitch who showed me that photography could be much more than a pleasant pastime; William Mortensen who charted my course in pictorial photography; Charles Shipman for advice on many technical matters; George Allen Young who encouraged and helped the production of this book; and Coletta Buehner for her assistance with the manuscript.

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FOREWORD

THE PURPOSE OF THIS BOOK

This is not just another book on photography. It would be an entire waste of time to rehash what has been in print for many years. Yet in spite of all that has been written, the perfection of technique is still the chief worry of most photographers.

If the average photographer were not hampered with the details of technique his pictures would improve immeasurably. He would concentrate on pictures themselves, confident of his own ability to cope with any scene and any subject. Unhampered by technical details his imagination would have full play and, therefore, his work would be less imitative than it is today.

It is easy enough to operate the camera to make some sort of record of any scene toward which the camera is pointed. It is another thing to make the camera record the scene the way in which the photographer requires it.

The purpose of this book is to clear away the confusions and prejudices that stand in the way of the photographer's making the camera do his own will, for the camera can make many different records of the same scene. Curves, equations and logarithms are all very well in their proper place but the masters of photography make their pictures with cameras and films, not with logarithms.

There is not a graph, logarithm or H and D curve here but the facts and figures are explained with a series of experiments following each chapter to drive home these facts. The experiments are the practice necessary to make these facts part of the photographer's *usable* knowledge.

If the photographer will perform these simple experiments he will realize the part played by each of the important features in making a picture. Development, for example, will no longer be all important, for the other equally important factors that influence negative quality will also be understood and properly respected. The photographic process will be viewed as the result of a number of balancing features rather than as a series of separate unrelated individual steps.

To the photographer whose goal is the perfection of technique, so that any photographic subject can be properly handled without guesswork and consequent uncertainty, this book will be a guide.

The title "Make Your Pictures Sing" comes from the expression used by photographers and photo-engravers in describing a technically perfect piece of work.

PAUL LOUIS HEXTER, A.R.P.S.

March 1940
Cleveland, Ohio.

Chapter One

PHOTOGRAPHIC CONSIDERATIONS

There are two general schools of thought in photography—the Purist and the Pictorialist. The Purist believes once the shutter is snapped the process is photo-mechanical and manual manipulation is a violation of the medium. To him the technical part of photography is standardized to such an extent that it permits little control any time after the picture has been taken. Pictorialists on the other hand make little effort to standardize any of their procedures. They insert so much flexibility into the process that it sometimes seems that their pictures are created after they have the negative just because a pleasing arrangement happens to be found.

The adherents of the extreme views of these schools make the mistake of stressing the way in which the photographic process is used, rather than looking toward pictures which can be produced by photography. Edward Weston stops a lens down to f:256 for the ultimate in depth of field and contact-prints all his pictures. (Fig. 1.) His methods, however, have little to do with the value of his pictures, for others work the same way and produce nothing. Leonard Misonne makes sharp negatives but purposely diffuses them, printing in the oil process. (Fig. 2.) Diffusion and the oil process are only tools with which he works. In themselves they do not make his pictures. It is the pictures which must be the ultimate aim of the photographer, not the methods by which they are produced.

In painting Claude Monet believed that outline in nature was an illusion appearing only when one color is placed adjacent to another.

"Juniper," Tenaya Lake, 1937 — Edward Weston

Figure 1

Therefore, he painted in this fashion. (Fig. 3.) Other painters, such as Matisse, believe that form is best suggested through outline, place their line on the canvas and paint around it. (Fig. 4.) Both Monet and Matisse are men of recognized genius but it is the finished canvas which is the masterpiece, not the particular way in which they applied their paint.

Just as Monet and Matisse work with a blank canvas, a few tubes of color and some brushes to produce widely different paintings, so Edward Weston and Leonard Misonne use a light-tight box, several lenses and an assortment of film to produce photographs which are just as far apart. Both strive for the production of a negative which will register all the subtle tone gradations of the subject, although their presentation of the subject is widely different.

Here is the end toward which the technique of photography must be directed . . . the registering of the maximum number of subtle tone gradations in every subject. This is where photography is so superior to every other form of art, and, therefore, it is the end toward which the technical part of photography must be directed.

THE PURPOSE OF TECHNIQUE

The keystone of perfect photographic technique is standardization. The entire technical process should be looked upon as a series of unchangeable mechanical operations, always performed in the same manner and always giving predetermined results. These steps can be punctuated here and there with flexible means of control for the creative purpose of emphasis, selection and exaggeration. The flexibility, however, must never interfere with the standardization of procedure. It is obvious that with constant change of film stock, a new developer every week, and the search for the chimerical camera that always takes good pictures, consistent results are impossible.

In a chemical laboratory complicated experiments are carried out by holding all the steps in the experiments rigidly constant and admitting only one variable at a time. As the work continues the variables that effect the results favorably become standard procedure and eventully the experiment is carried through from beginning to end with predetermined knowledge of a successful conclusion.

The technique of the photographic process is such a laboratory experiment. The technique must be conceived so that all the vari-

"Sale Temps" *Leonard Misonne*

Figure 2

"Antibes" *Claude Monet*

Figure 3
Courtesy Cleveland Museum of Art

ables are fully controlled, and preconceived results can be obtained for every picture. Subject, exposure, film stock, development and printing methods must all be standardized and held rigidly the same. It is utter nonsense to change any one part of the photographic process unless all the other parts have been held constant.

The production of fine photographs depends entirely upon the subjection of all technical operations to matter-of-fact routine procedure so that all efforts can be placed on the far more difficult problem . . . the picture. The photographer who has standardized his procedure and knows his technique will turn out good work with almost any camera, any film, and any developer. These are only the tools with which he works and are to him as brushes are to a painter. Technique by itself means nothing . . . it is only the foundation upon which the building is constructed. Technique never has been and never will be an end in itself.

"Girl with Green Eyes" Henri Matisse

Figure 4
Courtesy Museum of Modern Art

TECHNIQUE AND CREATIVE WORK

The camera is a small mechanical machine for the recording of actuality and nowhere is the domination of the machine over man more in evidence. If we continue to let this machine dominate us we will worship the mechanized product of the camera. If, on the other hand, we dominate the machine, we will use its fundamental qualities to create pictures, to express our thoughts and feelings, and to create beauty. Great things will be done by the camera if man runs the machine but never if the machine runs man.

Many workers in photography become so involved in the perfection of their technique they forget creative work entirely. Perfection of technique is the essential requirement of creative work in the fullness of the photographic medium but it is a means toward an end only, not the end in itself. To reach perfection in technique must be the goal for everyone but after it has been reached all efforts must be concentrated on creative work.

Photography is a fine art. In the future it will be recognized as a great art, for photographers will use the camera to do great things. Painting has taken 600 years to achieve its present status and the minds of some of the most brilliant men in the past centuries contributed to it. Today men like Moholy-Nagy believe that painting in the tradition of the past has outlived its usefulness to our civilization primarily because of the development of photography. Photography will not require 600 years to arrive but it will require men of genius just as painting has done.

Chapter Two

NOTES ON EQUIPMENT

Every photographer collects a miscellaneous assortment of photographic accessories in his efforts to improve his work. Many of these gadgets are discarded shortly after they are acquired. While good pictures can be taken with almost any piece of equipment, some equipment lends itself more readily to certain types of work.

Photographic equipment should be accumulated slowly with full comprehension of the uses and limitations of each separate article. It is much better to buy equipment knowing that it will be constantly used, than to spend more than is necessary assuming that some day it might be useful. Purchase only what will be regularly used and save the balance for something that will be needed in the future. Above all, remember it is not the particular camera, or the particular lens that makes the pictures. It is the knowledge of pictures, what they are, and how to make them that counts.

THE STUDIO

A studio of some sort should be available for any serious indoor work. The minimum requirements are a room with a nine-foot ceiling, a white wall area ten feet wide at one end, and clear working space in front of this wall for a distance of at least fifteen feet. Double these dimensions make an ideal studio with freedom and ease of working assured on all occasions.

The family living room can always be commandeered as a studio, if necessary, and a portable white background can be used. The background can be made from a white window shade of suitable

"Nude"
Figure 5
Hollywood Coffin in use.

width. A studio of this kind, however, entails much furniture moving for every picture and is a general nuisance to everyone, including the photographer.

Two accessories for posing are of great value in portraiture. The old-fashioned piano stool that can be raised or lowered by turning the seat around makes an ideal posing bench. As there is no back support, the subject assumes an erect position on being seated and once a pose is taken turning from side to side at the direction of the photographer is easily accomplished without breaking the pose.

The other accessory is known as a Hollywood Coffin. This is a box six feet long, eighteen inches wide, and thirty inches high made from three-fourths inch stock, painted white. The box need not be closed in on the back or bottom which makes it lighter and easier to move around. It is used as a posing platform, a posing bench, or as an accessory in composition. (Figs. 5 and 6.)

CAMERAS

The ideal camera for studio work is a reflex. There is a real

"Wendy"
Figure 6
Hollywood Coffin in use.

advantage in having the image on the ground glass up to the moment of taking the picture and the niceties of composition, as well as the appearance of the subject, are easy to observe. There is no particular point in using a reflex larger than $3\frac{1}{4} \times 4\frac{1}{4}$ for this work.

Ordinary cameras with ground glass backs for focusing should be avoided because the insertion of film holders before the exposure is distracting to both the model and the photographer. The less the photographer fusses with his equipment, the more he can concentrate on the picture at hand.

In studio portraiture exposures will range from one-tenth to one-half second which requires the placement of the camera on a firm, vibrationless tripod. The best tripod will be the cheapest in the long run for any slight vibration will ruin the finest picture. Any loss of definition in a correctly processed negative, when enlarged, is usually due to a slight vibration from an insecure tripod.

There are two aids to sharpness in portraiture with a reflex that can be used to great advantage. Reflex cameras usually show the

slowest shutter speed at one-tenth second. Exposures as slow as one-fourth second are made by setting the curtain at open and pressing the mirror lever. The mirror is thrown out of the way and the curtain closes at the same time. Operating a reflex in this manner often causes vibration. Therefore, a detachable, before-the-lens shutter, operated by a cable release is much to be preferred for slow portrait exposures.

Another aid to sharpness with a reflex is a magnifying glass for critical focusing. Measure the distance between the top of the hood and the ground glass and subtract two inches. Purchase a spectacle lens of roughly this focal length.* The lens can be attached to the temple of a cheap spectacle frame, the temple cut off at the proper distance, and the upper end bent to form a small hook that can be hung in one corner of the reflex hood. Critical focusing is easily checked on any part of the image with this glass just before the picture is taken.

For outdoor work the 3¼ x 4¼ reflex camera is too bulky, too heavy, and reflex focusing is a detriment rather than an asset. When a lens is stopped down to f:16 there is not much of an image on the ground glass with which to focus. Focusing with the lens wide open and then stopping down is quite awkward. Therefore, the smaller roll film cameras are preferred. The ideal combination is to have a 3¼ x 4¼ reflex for studio work and a smaller camera for outdoor work.

The only disadvantage of the roll film camera is the inability to use film other than that with which the camera is loaded. Having a reflex available, along with a roll film camera gives complete flexibility in equipment and enables the larger camera to be used when a change in film stock is indicated.

CUT FILM, ROLL FILM, OR FILM PACKS

The film pack is the most convenient and easiest form in which to use film. It takes but a second to put a new pack in place and successive films are changed with a minimum of commotion, a distinct advantage when working rapidly, as in portraiture. Roll film is next in convenience and has the advantage of being obtainable

* The focal length of a spectacle lens is measured in diopters. To change the focal length in inches into diopters, divide the number of inches into 40. Thus a five inch lens would have a focal length of 8 diopters.

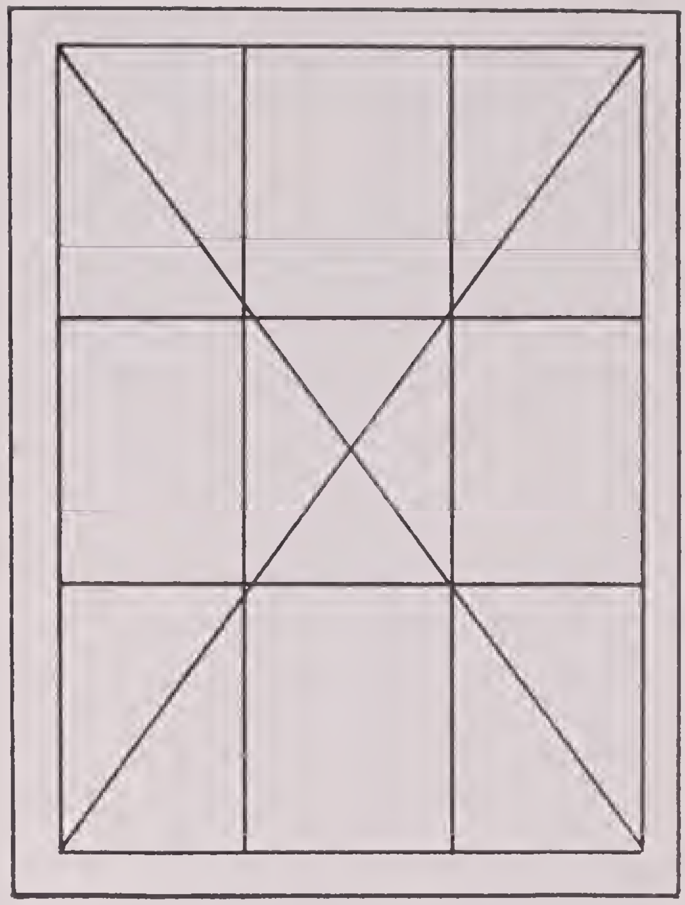

Figure 7
The ruled ground glass.

almost anywhere, an advantage appreciated when travelling in out-of-the-way places.

Cut film is the least convenient to use because it must be loaded individually in the dark room in single or multiple cut film holders. This is an annoying nuisance when a lot of work is to be done unless one has an assistant to perform this sort of drudgery. The advantage of cut film, however, is in the much wider variety of emulsions available than in either roll film or film pack, as well as the fact that individual shots can be made without going into the dark room with an unfinished pack or roll.

The easiest procedure is to use film pack or roll film for all regular work and cut film when special emulsions or one or two shots are required. If film packs are purchased 12 at a time the cost is about the same as single boxes of cut film.

RULING THE GROUND GLASS

The advantage of the reflex camera is that the image is always visible on the ground glass up to the minute of exposure. Most ground glasses on reflex cameras, particularly on those cameras with revolving backs, have a larger area than the actual picture size. This causes confusion when the composition of the picture is arranged according to the ground glass, as the area of the negative is actually

less. Therefore, it is advisable to rule guide lines on the ground glass limiting the picture area to the size that will be included on the negative.

As a matter of fact it is advisable to rule the ground glass with an area slightly less than will be reproduced on the negative. This will enable further refinement and arrangement of composition on the enlarging easel. With a $3\frac{1}{4} \times 4\frac{1}{4}$ negative, the actual picture size is 3 x 4. A satisfactory area to rule on the ground glass in this case is $2\frac{3}{4} \times 3\frac{3}{4}$. Additional rulings which aid in composition and alignment are made by dividing the area into thirds and ruling diagonal lines. (Fig. 7.)

The ground glass is easily removed from the reflex hood and the rulings made with a lead pencil on the ground side of the glass. Care should be taken to replace the ground glass with the ground side face down as it was originally found.

EXPOSURE METERS

An exposure meter of the photoelectric cell type is as essential to own as the camera itself. The photographer who guesses at proper exposure based on experience tables, or his own estimate of brightness is a waster of film on a large scale. No eye can approach the accuracy of a photoelectric cell in gauging the amount of light reflected by any subject, or part of a subject.

In modern photography which places the tone range of the subject on a definite portion of the negative scale, exposure must be extremely accurate. This can be done most conveniently by using an exposure meter of the photoelectric cell type. The scales on these instruments giving the relation between exposure time and diaphragm setting save much mental labor and prevent the possibility of error through inaccurate calculation. The use of an exposure meter is not an admission of photographic incompetence but, on the contrary, is the only intelligent approach to the entire subject of exposure.

THE DARK ROOM

Dark rooms are much like the title of the motion picture, "Gold Is Where You Find It." Fortunate indeed is the photographer who can have one built to specification instead of utilizing an unused basement room. Many good ideas on dark rooms will be found in

Figure 8

Figure 9

"How To Build & Equip a Modern Darkroom" by Barrett & Wykoff.

The double door, common to the commercial photographer's dark room, is no longer necessary. Any ordinary door can be weather stripped and made completely light-tight. Any windows in the room can be fitted with an inside hinged shutter which is also made light-tight by weather stripping. (Fig. 8.)

If possible there should be two water outlets for cold and hot water and one of these outlets should be fitted with a mixer faucet enabling the temperature of the water to be controlled. If any wiring can be done, arrange each safe light on a separate switch and control all of them from one place. Put enough base plugs at bench height for all apparatus so that continuous plugging in and out is not necessary.

The most convenient place for the contact printer is mounted flush with the work bench. (Fig. 9.) Iron brackets strong enough to hold it firmly in place can be obtained at any hardware store. Mounting the printer in this fashion gets it out of the way when it is not in use, yet at the same time it is always ready. The space under the printer is just right to keep a five-gallon bottle of distilled water in a carboy frame so it is easily poured.

Plan as much shelving space as possible. No matter how much shelving is in any given darkroom, it is never too much. For covering floors and counters waxed asphalt tile is best. Black linoleum is second best. Alongside the sink a slate counter slab is a great convenience. The day of painting the darkroom black is gone. An attractive light gray chemical-proof enamel which will not be injured by acids, alkalis or photographic chemicals is manufactured by the Arco Company, Cleveland, Ohio, or Los Angeles, California, and sold under the name of "Chemox."

No more than three days after I had moved into a new darkroom which I had constructed (Fig. 8), a budding young photographer called on me. After looking over a number of prints and carefully inspecting the new darkroom he said, "Now if I had a place like that I could really do fine things too."

The work he had seen, however, was from a make-shift basement darkroom similar to thousands of others all over the country. Not a picture had been made in the new room. Darkrooms do not make pictures.

Chapter Three

LENSES, FOCAL LENGTH AND PERSPECTIVE

The modern craving for speed has been exploited by the manufacturer of lenses as well as the manufacturers of automobiles. It comes from John Q. Public's belief that speed and efficiency are cause and effect; which they undoubtedly are, but within certain limits.

On September 16, 1938, Captain George E. T. Eyston drove his "Thunderbolt" racer over the salt flats at Bonneville, Utah, at a speed of 357.5 miles per hour. This is faster than any automobile had ever been driven before and faster than most people have any desire to go in an automobile. Reaching this speed meant a complete change of tires after every run. This is speed but at the expense of many tires.

The modern ultra-speed lens is also an example of great speed but at the expense of other factors. The untutored photographic public believes the best lens is the fastest lens. They reason: the best is always the most expensive; fast lenses are most expensive; therefore, fast lenses are the best. The mistake is in the premise that the best is always the most expensive. It is not always true.

In considering the purchase of a lens, remember no lens manufacturer, as yet, has ever claimed that picture quality improves with the speed of the lens. Just as an automobile after a certain point loses efficiency with increased speed, so do lenses. Users of high

speed lenses stop them down for most pictures and, although an f:2 lens and an f:6.3 lens of the same focal length when stopped down to the same stop are theoretically equivalent, the fast lens will often have a tendency to lose definition at the smaller stops.

The disadvantages of speed lenses are excessive cost, some loss of definition at smaller stops, and limited depth of field when used wide open. The only advantage is speed if you ever need it. Good pictures, however, are seldom taken with insufficient light, even with fast lenses.

That speed lenses have a habit of losing definition at certain stops is not generally known and it is always advisable to test the definition of every lens at all stops, before it is purchased. This test is easily made by arranging a series of books which have titles printed on their covers, across a long table or Hollywood Coffin, with the titles fairly well in line. (Fig. 10.) Place the camera as close as possible and focus on the middle book. Make an exposure at each aperture, increasing the exposure, of course, as the lens is stopped down. An examination of the book titles on the negatives will show at which stops definition is lost and those stops should not be used with that lens. The test made in Figure 10 proved definition at f:16 and f:22 was not so good as f:11. The other stops were all satisfactory. So stops f:16 and f:22 should not be used with that lens.

FOCAL LENGTH IN PORTRAITURE

The old time professional portrait photographer always used the longest focal length lens and the largest aperture his pocketbook could stand. Portraits were taken with the narrow plane of the eyes and mouth in sharp focus but every other plane out of focus. Increasing fuzziness back from the sharp plane of the eyes and mouth was supposed to create the illusion of depth. Usually all it accomplished was to fuzz up the ears so they looked like bits of old cloth tacked on each side of the head.

Modern portrait negatives require the entire image in sharp focus and the illusion of depth is secured by emphasis on modeling rather than by out of focus planes. (Frontispiece.) As a lens is stopped down the plane in front of the lens in which every object is sharp, widens out. In working, the lens is stopped down to f:8, avoiding the

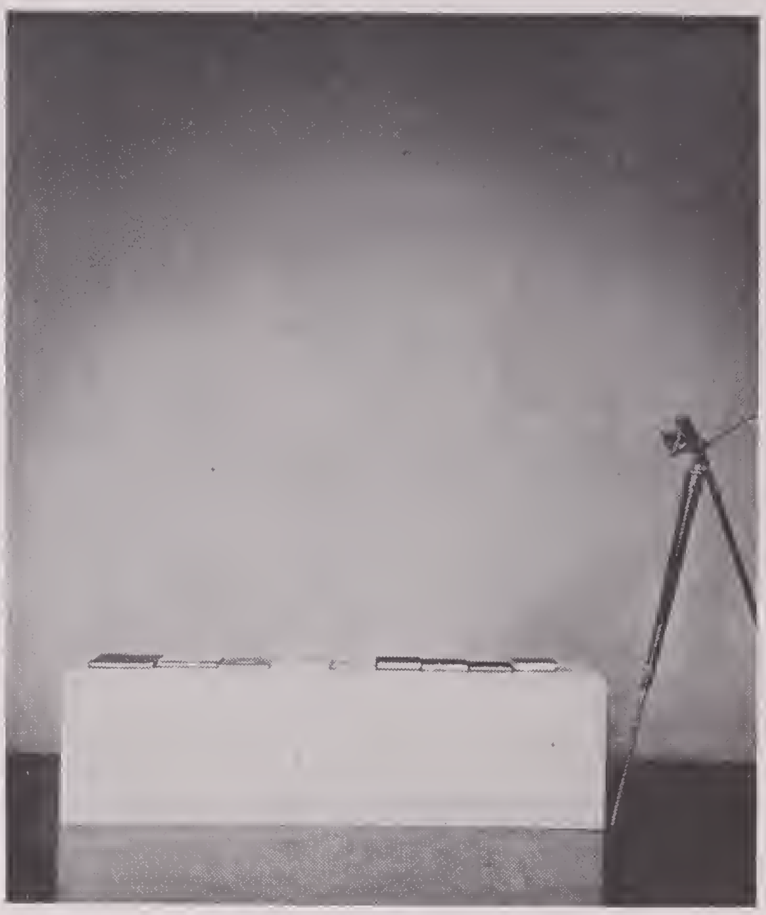

Figure 10
Testing lens Definition.

lack of sharpness caused by insufficient width of the sharp plane in front of the camera.

As long as the focal length of the lens permits a large head to be taken with the camera no nearer than four feet from the subject, no unavoidable distortion will occur. In a studio of the dimensions given, a lens for 3¼ x 4¼ reflex work should have a focal length of 6½ to 7 inches and does not need an aperture larger than f:6.3 or f:6.8. The focal length for portraiture should be roughly 25% more than the diagonal of the film size. While this focal length is recommended for studio work, it will be equally applicable to all outdoor work.

As far as better "drawing" and freedom from distoritiion in long focal length lenses is concerned, this is entirely a matter of the working distance from the subject, not a special property of the lens. Perspective depends entirely on where the lens is placed, not on the focal length or angle of view. A 6½″ lens for a 3¼ x 4¼ camera would be placed at the same distance from the subject as a 15″ lens on an 8 x 10 camera. These are fairly long focal length lenses.

PERSPECTIVE

The painter in constructing his picture is a builder. Starting with

a blank canvas, he adds line by line and area by area, creating his picture so that all lines harmonize with other lines, all areas harmonize with other areas, and all elements properly relate in size to the canvas and to each other. Thus painting is an addition process. If in nature the proportions are not right for the picture size, the painter changes them.

The photographer with his mechanism for recording actuality always finds the elements of nature haphazardly arranged. His is no step by step process of adding elements to other elements and fitting them nicely into a given space. The elements are there before his camera. Unimportant, undesirable details must be recorded along with desirable, important elements. Picture making for the photographer is primarily a matter of simplification, reducing a given scene to its important elements and eliminating all inconsequential and interfering details. It is a process of subtraction.

Once a photograph has been taken, the photographer has no means of altering the forms that make up his picture. The control processes give him a means of changing emphasis among the forms but the forms themselves are unalterably fixed at the time of exposure. While the photographer cannot transpose objects in the scene confronting him, he can change apparent space relations and size relations between objects one behind the other. He can proportion the size of his objects to fit best into the area of the film. He can keep a central object the same size and include either more or less background, or he can keep the background the same and change the size of the central object. These changes are made by varying the focal length of the lens, changing the point of view, or both, and may exert an important influence on the arrangement of any picture.

The photographic perspective, or the real and apparent size relation between objects is determined by:

(1) True perspective. The distance from the lens to the subject determines the size relation of objects one behind the other.

(2) Apparent perspective. The angle of view of the lens has the apparent effect of changing space relations of objects by changing the apparent distance from the camera.

The easiest way to understand these relationships is by illustration.

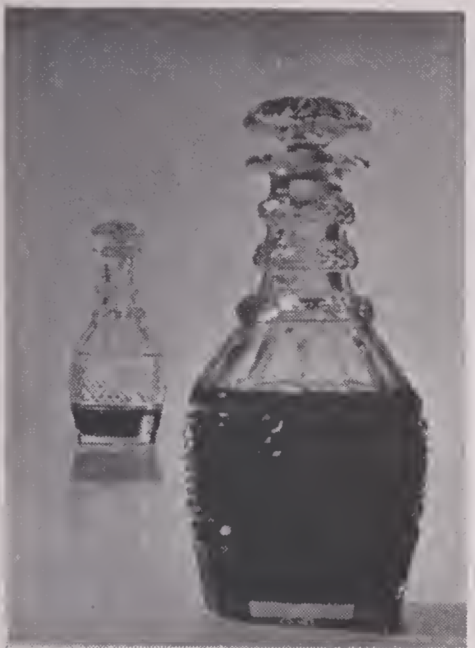

Figure 11
The Camera is $4\frac{1}{2}$ Feet from First Decanter.

Figure 12
The Camera is $9\frac{1}{2}$ Feet from First Decanter.

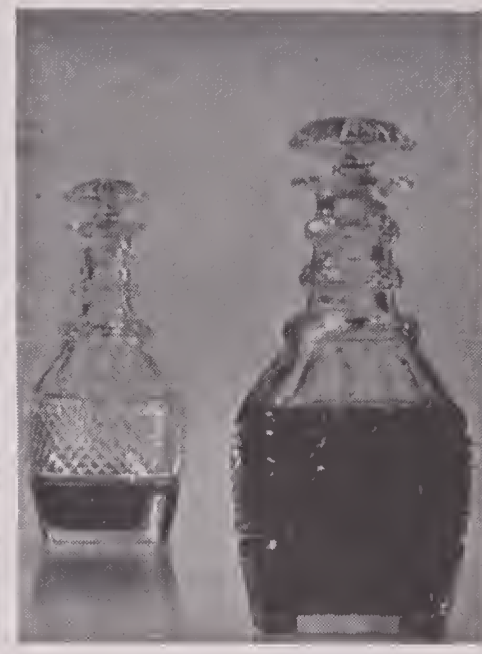

Figure 13
The camera is $9\frac{1}{2}$ feet from the first decanter but a longer focal length lens was used. Comparing the relative size of the decanters with Figure 12 the perspective is identical. Apparently, however, the picture was taken from the same place as Figure 11.

TRUE PERSPECTIVE

Figure 11 is a photograph of two decanters exactly the same size. The decanters are nine inches high and are five feet apart. The first decanter seems very close. The second decanter appears one-third its size.

Figure 12 is a second exposure from a viewpoint farther away. Both decanters are much smaller but the important point is, the second decanter is now two-thirds the size of the first decanter. The more distant point of view has changed actual size ratio between the decanters from one-third to one, to two-thirds to one. This is true perspective.

Figure 13 is a third exposure made from the same position as in Figure 12 but with a longer focal length lens. Again the first decanter fills the picture size. Notice, however, that the second decanter is now two-thirds the size of the first. The true perspective has not changed but the apparent perspective has. The longer focal length lens apparently brings the camera closer to the subject but it actually keeps the perspective the same. Thus the change is in apparent perspective only. If actually you were closer, the true perspective would be as in Figure 11.

APPARENT PERSPECTIVE

Figure 14 is a house photographed from a distance twice the width of the house with a 30° angle lens. This is about the position a man would assume observing the house carefully and 30° is the natural angle of sight. This photograph, then, represents what the average person would see if he were to observe the house.

Figure 15 is a second exposure from the same place with a lens of shorter focal length giving an angle of view of 70°; much larger than the natural angle of sight. It appears that the camera has been moved further back. An illusion of space is created. This is apparent perspective. Actually the camera was not moved.

Figure 16 is a third exposure from the same place with a long focal length lens. This changes the angle of view to 20°; less than the natural angle of sight. Space now appears contracted and the camera seems closer. Again the camera was not moved. This illustrates apparent perspective. Actual perspective changes only when the point of view changes.

The following conclusions can be drawn regarding photographic perspective:

(1) The difference in size between two objects, one behind the other, is determined solely by the point of view. The focal length of the lens, angle of view, or degree of enlargement, will not change actual size relations between two objects. These can be changed only by moving closer to or farther away from the subject. Therefore, to change the size relationship between two objects, one behind the other, the point of view must always be changed.

(2) The size accorded a principal object determines the *apparent* distance from the camera. This is apparent perspective and is subject to considerable change by varying the angle of view of the lens. A wide angle (short focal length) makes the object appear more distant, a narrow angle (long focal length) makes the object appear closer.

(3) To change apparent perspective or the *size of any principal object* the focal length of the lens is changed but the

Figure 14
7″ Lens $3\frac{1}{4} \times 4\frac{1}{4}$ Camera 75 Feet from the Subject.

Figure 15
$3\frac{1}{2}$″ Lens $3\frac{1}{4} \times 4\frac{1}{4}$ Camera 75 Feet from the Subject.

Figure 16
12″ Lens $3\frac{1}{4} \times 4\frac{1}{4}$ Camera 75 Feet from the Subject.

same point of view is taken. To change actual perspective or the *size relationship between two objects,* the point of view is changed but the same focal length can be used. The larger any object is rendered the closer the point of view appears to be. In Figure 18 the columns are much larger than in Figure 17. The point of view appears much closer. Actually Figure 18 was made with the camera twice as far from the subject.

PRACTICAL APPLICATION

With the principal object of satisfactory size (Fig. 17) a more distant viewpoint with a longer focal length lens to keep the principal object the same size (Fig. 18) will:

(1) Decrease the field or amount of subject area covered.
(2) Give greater prominence to a smaller background area.
(3) Increase the apparent size of all objects behind the principal object.
(4) Decrease the apparent distance between the principal object and background.
(5) Decrease the apparent distance between the principal object and any object behind it.
(6) Avoid violent perspective.

With the principal object of satisfactory size (Fig. 17) a closer point of view with a shorter focal length lens so the principal object remains the same size (Fig. 19) will:

(1) Increase the field or amount of subject area covered.
(2) Give less prominence to a larger background area.
(3) Decrease the apparent size of objects behind the principal object.
(4) Increase the apparent distance between the principal object and background.
(5) Increase the apparent distance between the principal object and any object behind it.
(6) Give violent perspective.

In practice it is not always possible to select a new point of view in relation to the principal object, which, with the focal length lenses available, will keep the principal object exactly the same size it was originally. The new point of view is determined by the visual per-

Figure 17
7" Lens, $3\frac{1}{4}$ x $4\frac{1}{4}$ Camera, 25 Feet from the Subject.

Figure 18
12" Lens, $3\frac{1}{4}$ x $4\frac{1}{4}$ Camera, 60 Feet from the Subject.

Figure 19
$3\frac{1}{2}$" Lens, $3\frac{1}{4}$ x $4\frac{1}{4}$ Camera, 11 Feet from the Subject.

Keeping the principal object the same size but changing background areas.

spective of the scene, comparing the actual size relationships between the principal object and the secondary object. When the point of view is determined, the picture is taken with a lens of the proper focal length. If an extremely long focal length is required and not available a further increase in the size of the principal object is secured in enlarging. Taken from the same point of view, and enlarged to the same size, a print made with a normal focal length lens is identical to a print made with a long focal length lens.

The apparent change in perspective achieved with lenses of different focal lengths, *from the same camera viewpoint,* will make wide differences in the linear composition of certain scenes, although the fundamental law is that perspective does not change unless the camera position changes. The effect on the linear composition of certain subjects can be very marked.

In Figures 14, 15 and 16, all made from the same camera position, the only effect is one of progressively moving closer to the subject. This is because the principal object is in one plane parallel to the camera. There are no lines converging in the distance.

In Figures 20 and 21 where parallel lines are converging, the entire linear composition of the scene is changed. Apparently the perspective has changed but actually it is the same as is proven by

Changing converging parallels from the same viewpoint.

Figure 20
7" Lens $3\frac{1}{4}$ x $4\frac{1}{4}$ Camera

Figure 21
$3\frac{1}{2}$" Lens, Same Camera, Viewpoint as Fig. 20

Figure 22
Enlargement of Fig. 21 to the Exact Size of Fig. 20

Figure 23
7½" Lens, 3¼ x 4¼ Camera.

Figure 24
3½" Lens, Same Camera, Viewpoint as Fig. 23.

Figure 25
Enlargement of Fig. 24 to the Exact Size of Fig. 23.

Changing the shape of a receding curve from the same viewpoint.

Fig. 22. When the illusion of depth is created in a picture by lines converging toward the horizon a great increase in depth can be achieved with a shorter focal length lens.

In Figures 23 and 24 dealing with curves receding out of the picture area, again the linear structure of the composition can be changed. Curved lines can apparently be made to curve more or less as is required. Fig. 25 proves that the actual perspective has not changed although the effect of the entire composition is different. These changes in composition with long and short focal length lenses cannot be properly visualized just by observing the scene from the camera viewpoint. A ground glass in the camera is absolutely necessary.

These facts of perspective in relation to the position of the camera and the focal length of the lens should be thoroughly familiar to every camera user for without these facts as part of your technique many opportunities for the improvement of pictures will be lost. Instances where this knowledge is a great asset occur daily in the life of every photographer and for the purpose of clarity and emphasis the facts of these practical applications are restated in somewhat different form.

(1) An increase of image size accomplished by the use of a longer focal length lens is always accompanied by a decrease of field. Compare Figs. 15 and 16.

Figure 26
Short Focal Length Lens Close to Principal Object, 3½" Lens.

Figure 27
Long Focal Length Lens Away from Principal Object, 12" Lens, 3¼ x 4¼ Camera, Distance about 70 Feet.

Keeping background area the same size while changing the size of the foreground object.

(2) A decrease of field always means an increase in the image size of any object in the field. Compare Figs. 17 and 18.

(3) An increase of field always means a decrease in the image size of any object in the field. Compare Figs. 17 and 19.

(4) To increase the size of background objects (decrease the field) keeping foreground objects the same size, use a longer focal length lens and a more distant viewpoint. Compare Figs. 17 and 18.

(5) To decrease the size of background objects (increase the field) keeping foreground objects the same size, use a shorter focal length lens and a closer viewpoint. Compare Figs. 17 and 19.

(6) To increase the size of a foreground object keeping the background objects the same size, use a shorter focal focal length lens and a closer viewpoint. Compare Figs. 26 and 27.

(7) To reduce the size of a foreground object keeping the

Figure 28
7" Lens, $3\frac{1}{4} \times 4\frac{1}{4}$ Camera, 5 Feet from Subject.

Figure 29
$3\frac{1}{2}$" Lens, $3\frac{1}{4} \times 4\frac{1}{4}$ Camera, 20 Inches from Subject.

Violent Perspective. The poses are identical.

background objects the same size, use a longer focal length lens and a more distant viewpoint. Compare Figs. 27 and 26.

(8) To avoid violent perspective, use a longer focal length lens and a more distant viewpoint. Conversely a short focal length lens and a near viewpoint will produce violent perspective. Compare Figs. 28 and 29.

(9) To include more of the subject without changing perspective use a shorter focal length lens from the same viewpoint. Compare Figs. 14 and 15.

(10) To include less of the subject without changing perspective use a longer focal length lens and the same viewpoint. Compare Figs. 14 and 16.

SUPPLEMENTAL LENSES

To take advantage of the possibilities for better picture arrangement in varying focal lengths of lenses, it is not necessary to own five or six lenses. Supplementary lenses can be purchased at small cost

from the photographic supply houses. For example, George Murphy, Inc., New York, N. Y., sells a set of four lenses 2″ in diameter for $7.50.

This particular set used with a 7″ lens gives the following variations:

	Focal Length	*Angle of View*	*Units of Exposure*
Regular Lens	7″	40°	1
Plus Supplement 1	4″	70°	2 stops faster
Plus Supplement 2	5¼″	58°	1 stop faster
Plus Supplement 3	10″	30°	1 stop slower
Plus Supplement 4	15″	20°	2 stops slower

The holder that comes with these supplementary lenses is usually unsatisfactory for permanent use. It is suggested that Eastman round filter holders of the proper size be used for lens mountings.

In order to find out how the supplementary lenses affect the focal length and f: numbers of a regular lens, it is necessary to know the focal length of the supplementary lens. This usually does not come with the lens and the easiest way to find it is to have an optician measure it. He has a little instrument which measures the curvature of the glass and a chart which translates the readings into inches of focal length.

In calculating focuses, a convex radius is prefixed by a plus sign (+) and a concave radius is prefixed by a minus sign (—). The optician will tell you whether the focal length has a plus or a minus prefix.

To find the combined focal length where f_1 is the focal length of the regular lens and f_2 is the focal length of the supplementary lens, use

$$\frac{f_1 \times f_2}{f_1 + f_2}$$

This assumes the lenses are close together. If there is any separation use

$$\frac{f_1 \times f_2}{f_1 + f_2 - s} \quad \text{where s is the separation.}$$

In working the above formulas, when multiplying or dividing quantities whose signs are *alike* the answer is always plus. When mul-

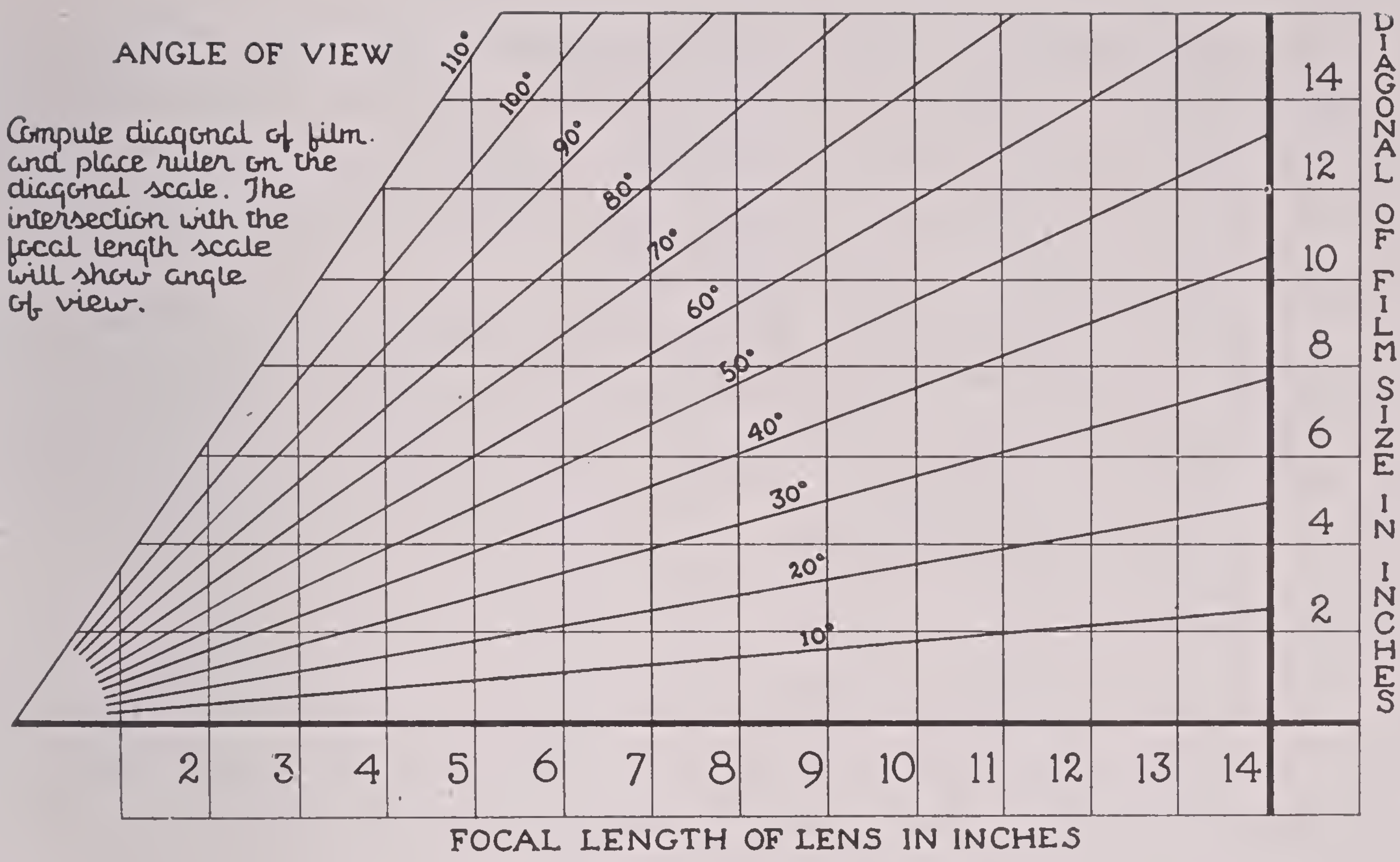

Figure 30

tiplying or dividing quantities with opposite signs, the answer is always minus. When adding and subtracting take the sign of the largest number.

For example, suppose a regular lens has a focal length of 7″ and it is combined with a supplementary lens with a focal length of—26″

$$\text{Combined Focal Length} = \frac{(+7) \times (-26)}{(+7) + (-26)} = \frac{-182}{-19} \text{ or } 9.5''$$

To find the alteration in f: numbers of the combined focal lengths, multiply the new focal length by the original f: number and divide the product by the original focal length. For example, using the above lens at f:8 multiply 9.5 x 8 which is 76. Divide by 7, the original focal length, and the answer is 11. So the stop alters from f:8 to f:11. This combination will always be one stop slower than the original lens.

An easy way of finding the approximate angle of view of a lens, or the combination of lens and supplementary lens is to use Fig. 30.

The angle of view of a lens is the angle of the cone of light proceeding from the lens back to the film encircling the film. The width of this cone at the film is equal to the diagonal of the film. The distance from the lens back to the film, when the lens is focused on infinity, is the focal length of the lens.

In using supplementary lenses, those which increase the focal length will require less bellows extension for a given magnification if used behind the original lens rather than in front of it. All supplementary lenses should be used at stop f:16 or at smaller stops to retain sharpness and definition.

FOCUSING

With most subjects focusing is not much of a problem. There is usually a principal object which is to be rendered sharply and focusing with a ground glass, coupled range finder, or distance scale is simple.

Some times, however, there are objects close to the camera which must be rendered sharply along with sharp backgrounds, and it is necessary to know the exact depth of field or width of the plane in front of the lens in which all objects are in sharp focus.

If a lens is focused sharply on infinity the nearest object in sharp focus is said to be at the hyperfocal distance. If the lens is now focused on this object everything will be sharp from half the hyperfocal distance to infinity.

If the hyperfocal distance for any particular focal length and stop is not in the table it can be calculated from the formula

$$H = 1000 \frac{f}{s}$$

where f is the focal length and s is the lens stop. Thus the hyperfocal distance of a 6-inch lens at stop f:11 is

$$H = 1000 \frac{6}{11} = 555 \text{ inches or approximately 46 feet.}$$

PRACTICAL USES

(1) If a lens is focused on the hyperfocal distance everything is in sharp focus from ½ the hyperfocal distance to infinity. Thus a 6-inch lens focused at 46 feet will have everything in sharp focus from 23 feet to infinity.

*Table of Hyperfocal Distances in Feet**

Focal Length Inches	f:2	f:2.8	f:3.5	f:4.5	f:5.6	f:6.3	f:8	f:11	f:16	f:22	f:32	f:45	f:64
2	84	60	47	37	30	26	21	15	11	8			
2½	105	75	58	47	38	33	27	19	14	10			
3	126	89	71	56	45	39	32	23	16	12	7		
3½	147	104	83	65	53	46	37	26	19	13	9		
4	168	119	92	75	60	52	42	30	21	15	10	7.4	
4½	189	134	105	84	68	59	48	34	24	17	11	8	
5	209	149	119	93	75	66	53	38	27	19	13	9	6.5
5½		163	130	103	82	72	58	41	29	21	14	10	7
6		178	142	112	89	78	63	45	32	23	15	11	7.8
6½			154	121	97	85	69	49	35	25	17	12	8.5
7			168	130	104	92	74	52	37	26	18	13	9
7½				138	111	99	78	56	39	28	19	14	10
8				146	119	105	83	60	41	30	20	15	10
8½				156	126	110	88	64	43	32	22	15.5	11
9				166	133	117	93	68	46	34	23	16.5	11.5
9½				174	140	123	97	72	48	36	24	17.5	12
10				182	146	129	101	75	51	38	25	18.4	13

*** Based on a circle of confusion of 1/100 inch. It is generally agreed that a disc of 1/100 inch viewed from 10 inches is indistinguishable from a point.**

(2) Prepare a table for each lens or combination of lenses and supplementary elements as follows:

Divide the hyperfocal distance of the lens wide open by 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, in succession.

For example:

A 7″ lens at stop f:4.5 has a hyperfocal distance of 130′. Dividing 130 by 1, 2, 3, 4, etc. up to 30 gives the following series:

130 Divided by...	1	2	3	4	5	6	7	8	9	10
Equals...	130	65	43.3	32.5	26	21.6	18.5	16.2	14.4	13
130 Divided by...	11	12	13	14	15	16	17	18	19	20
Equals...	11.8	10.8	10	9.2	8.6	8.1	7.6	7.2	6.8	6.5
130 Divided by...	21	22	23	24	25	26	27	28	29	30
Equals...	6.2	5.9	5.6	5.4	5.2	5	4.8	4.6	4.4	4.3

When focusing on any one of these distances with the lens wide open, the focus extends one step each side. Thus with the lens focused at 5 feet at f:4.5 focus extends from 4.8 feet to 5.2 feet.

When the stop is multiplied by 2 the focus extends two steps on each side. Thus f:4.5 multiplied by 2 is F:9. Focused on 5 feet at f:9 focus extends from 4.6 feet to 5.4 feet.

Multiply the stop by 3 and the focus extends three steps on each side, etc.

(3) Prepare a second chart for each lens and combination of lenses and supplementary elements for focusing as follows:
On a plain sheet of paper rule 25 steps down ¼ inch apart. Number them in fives from 0 to 125. Locate the various hyperfocal distances for each stop from the table on page 45. Calculate any steps that may not be in this table. In the illustration stops are located for a 6″ lens. From the point zero locate 20 steps across 3/16″ apart. Number these steps from 1 to 20. From point 20 measure down 2″. Draw a line connecting this new point with 0. Number this new line from 1 to 20. There are now two points on line 20. Locate the point in the center and draw a line from this point to zero. The chart should look like Figure 31.

Suppose a subject like the decanters (Fig. 11) is to be taken: the first decanter is 3 feet from the lens and the second decanter is 8 feet away. Placing a ruler on the farther point, 8 feet, and the nearer point, 3 feet, shows according to the dotted line that the lens should be focused at 4.5 feet and stop f:64 should be used.

While these charts may take an evening's work to compile, they are well worth the effort.

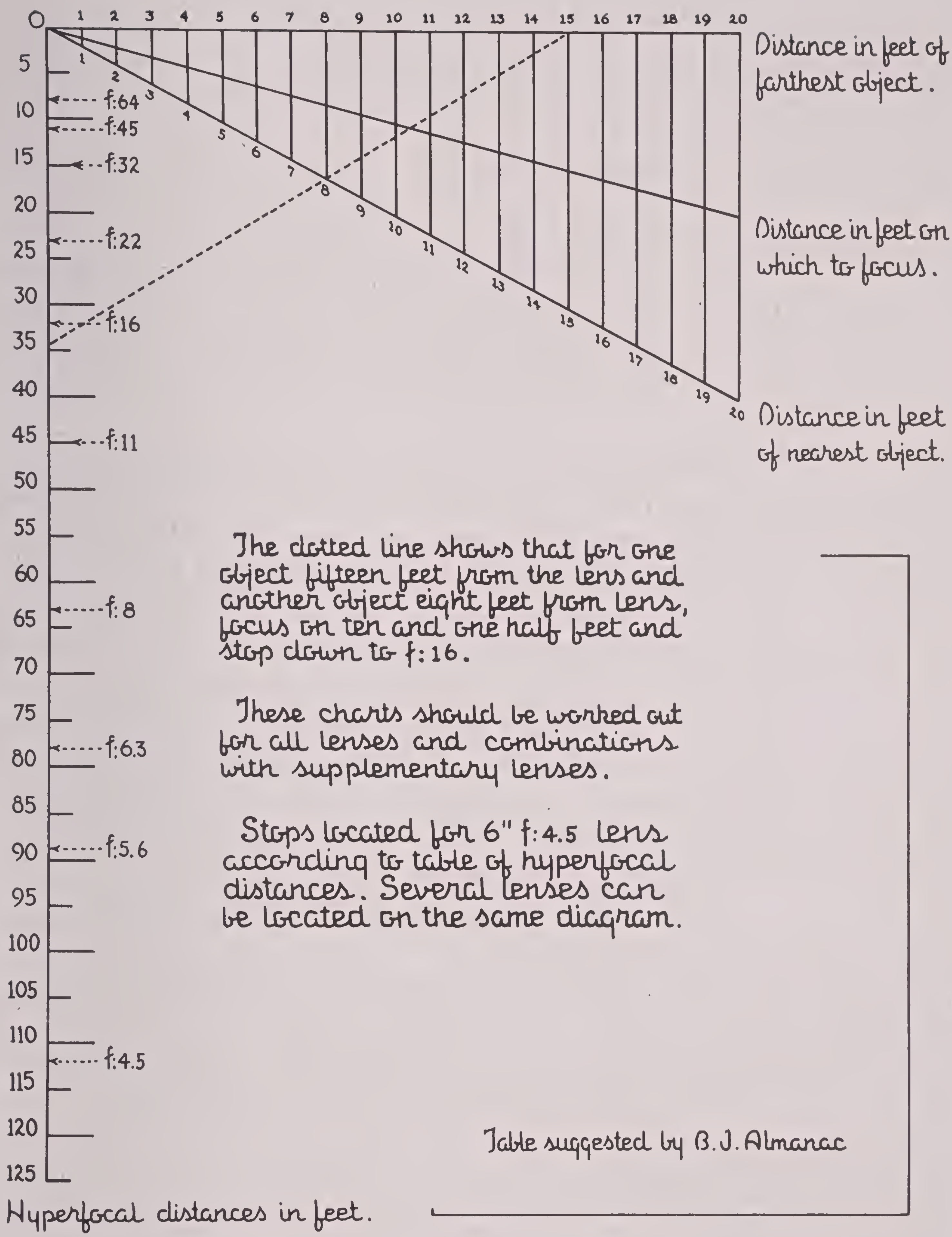
Distance in feet of farthest object.
Distance in feet on which to focus.
Distance in feet of nearest object.
f:64
f:45
f:32
f:22
f:16
f:11
f:8
f:6.3
f:5.6
f:4.5
The dotted line shows that for one object fifteen feet from the lens and another object eight feet from lens, focus on ten and one half feet and stop down to f: 16.
These charts should be worked out for all lenses and combinations with supplementary lenses.
Stops located for 6" f: 4.5 lens according to table of hyperfocal distances. Several lenses can be located on the same diagram.
Table suggested by B. J. Almanac
Hyperfocal distances in feet.

Figure 31

When in doubt as to where to focus, and charts and calculations are not available, select a point one-third of the distance beyond the nearest object. Focus and stop the lens down as much as possible.

EXPERIMENTS IN PERSPECTIVE

(1) *Decreasing the field*

Select a scene with a principal object in the foreground against a rather large background. Make one exposure. Now make a second negative decreasing the field of the background but keeping the principal object the same size.

A satisfactory subject would be a full-length figure well out from your house. Select a point of view so the figure occupies most of the picture area and stop the lens down so both the figure and the house will be sharp. Make the exposure. Drop back eight feet and with a longer focus lens make a second exposure.

Print the first negative so the figure occupies most of the picture. Enlarge the second negative if necessary so the figure is the same size. In comparing the two prints the figures are the same size but notice what has happened to the background. You have decreased the field.

Notice that you have also:

- (a) Given greater prominence to a smaller background area.
- (b) Increased the size of all objects immediately behind the principal object.
- (c) Decreased the apparent distance between the principal object and the background.

(2) *Increasing the field*

A satisfactory scene for the following pictures would be a farm house surrounded by a fence, the picture to be taken through an open gate. Take one picture with a regular lens showing both sides of the gate and the farm house framed by it.

With a shorter focal length lens move up closer to the gate, keeping the sides of the gate framing the picture and make a second exposure.

Print the first picture so the gate frames the farm house. Print the second picture so the gate is the same size as in the first picture. Compare the two prints and notice what has happened to the farm house. You have increased the field.

Notice also that you have:

(a) Given less prominence to a larger amount of background area.

(b) Decreased the apparent size of the house.

(c) Increased the apparent distance between the house and the gate.

(3) *Changing the apparent distance from the camera*

Make three exposures of your own home from the same point of view using a regular lens, a long focus lens and a wide angle lens, or their equivalents with supplementary lenses.

Which picture seems closest to the camera? Which seems to be farther away?

(4) *Overcoming violent perspective*

Pose a model about three feet in front of your camera with one hand six inches in front of the face and just to one side. Make the exposure. Make a print with the head filling almost the entire picture area.

Move back six feet and with a longer focal length lens make a second exposure. Enlarge this negative to the same size as the original print. Notice the violent perspective will be corrected by moving back from the subject and using a lens of longer focal length.

(5) *Increase of image size*

Pose a model in front of your own home about 20 feet out from the background. Make one exposure with a normal focal length lens. Then make a second exposure from the same camera position with a longer focal length lens to increase the size of the principal image. Notice the decrease in the background area (field) always accompanied by an increase in the size of the principal image.

(6) *Decrease of image size*

Make a third exposure of the same subject in Experiment 5 from the same camera position but with a short focal length lens to decrease the size of the principal image. Compare with the exposure made with the normal lens and notice that a decrease in the size of the principal image is always accompanied by an increase in the size of the field.

(7) *Increasing the size of the background*

With the same subject, a model in front of your home, make a normal exposure with a normal focal length lens and note the size of the principal object on your ground glass. (This is easy if the ground glass is ruled according to instructions on page 26.) Make a second exposure with a short focal length lens moving the camera closer until the principal object is approximately the same size on the ground glass. The size of the principal object is the same in both cases but the field has been greatly increased by moving closer with a short focal length lens.

(8) *Decreasing the size of the background*

Make a third exposure of the subject in Experiment 7, this time with a long focal length lens, moving the camera position back from the principal object until the principal object is again the same size on the ground glass as in the first exposure. Again the size of the principal object is the same but the size of the background is vastly decreased. Compare these prints and observe the changes in the composition of the picture made by modifying the background size.

(9) *Keeping the background the same size but decreasing the size of the principal object*

Again with the same subject, a model in front of your home, make a normal exposure with a normal focal length lens. Notice on the ground glass the borders of the background. Make a second exposure with a long focal length lens, moving the camera position back from the principal object until the background borders are

the same as in the first exposure. While the background remains the same size the principal object has decreased in size and, therefore, in importance.

(10) *Keeping the background the same size but increasing the size of the principal object*

Make a third exposure with a short focal length lens, moving closer to the principal object until the background borders are again the same as in Experiment 9. The principal object increases in size and importance while the background remains the same.

(11) *Including more or less of the subject from the same camera viewpoint*

Select a landscape scene and make three exposures from the same camera position with a normal, long and short focal length lens. Compare the three pictures. Notice that a short focal length lens includes much more of the scene while a long focal length lens includes much less of the scene.

(12) Make the same experiment on a scene with parallel lines converging in the distance as well as on a scene with curved lines going out of the picture area.

The relationship between the focal length of the lens and camera position for a given result will be easily understood if all these experiments are made. Nothing teaches one so well as doing it yourself. Make all these experiments and then reread this chapter. What may sound complicated and obscure will then become child's play. The obvious chance to improve the composition of any picture is too good to pass up.

Chapter Four

NEGATIVE MAKING

In 1906 George Bernard Shaw, then an amateur photographer, wrote, "Technically good negatives are more often the result of the survival of the fittest, than of special creation; the photographer is like a cod, which produces a million eggs in order that one may reach maturity."

Today, modern emulsions, photoelectric cell exposure meters for measuring light, and the great advance in technical knowledge make the million negatives unnecessary. However, many photographers still rely more on the laws of chance than on the principles which govern negative making in taking their pictures.

For many serious photographers the entire subject of negative making is a vast confusion of statements and contradictions. The subject is all mixed up. Books and periodicals serve only to add to the confusion for they tend to be too technical or overly simple. Probably the greatest delusion under which many photographers labor is in the field of development and developers. There is a great superstition abroad that some new developer formula will be the long sought answer to the production of perfect photographs. Like the magic words, "Open, Sesame!" some photographers expect the same results by saying, "Metol, Hydroquinone and p—Hydroxyphenylglycin".

Taking a few well known names at random it is found that Edward Steichen pronounces the words, "Metol, straight metol" to get his pictures. Edward Weston says "D-1 Pyro". Charles Kerlee says "Pyro-acetone" to his negatives. Ansel Adams waves his wand over

a developing tank and pronounces the same magic words as Edward Weston. William Mortensen uses a choice of two cabalistic phrases, one being D-1 Pyro and the other Metol-borax. Moholy-Nagy finds all the magic necessary printed on the instructions that come with the film.

The technique of these and all other successful workers is not due to the magic words in ordering their chemicals, or the way they put these symbols in use. That a number of different formulas are used by successful workers is well known, and this is evidence in itself that there is no one cabalistic combination used exclusively by the inner circle of famous photographers. These men are the Merlins of photography. The secret password to their group is *KNOWLEDGE*, not paraphenylene-diamine. As a matter of fact any good photographer can take any formula, as long as it will develop, and adapt it to his own work.

A negative is influenced by four factors:

(1) Lighting
(2) Exposure
(3) Film Stock
(4) Development

The importance of the proper negative for successful picture making cannot be over-emphasized. It is utterly foolish to attempt a fine picture from a poor negative. It just cannot be done. No one of the above four factors is more important than the other and ideal negative quality is the product of all four factors properly related, not just one factor alone.

Ideal negative quality, or the perfect negative, is a concept that requires clear definition, for in photography one man's perfect negative is another man's anathema. Here lies the basis for much existing confusion. The miniature negative, the negative for normal enlarging, the negative for contact printing, the professional portrait negative, the commercial negative, the press negative and the average snap-shot negative are all different strains of the same breed. It follows that a negative achieves perfection only when it gives the kind of picture required; not because it fulfills certain scientific measurements or fits certain arbitrary standards.

Often formulas and dissertations on negative processing appear in the photographic press unaccompanied by illustrations of the "be-

fore and after" kind. It is always well to question statements on any photographic subject unless there is accompanying proof in the form of pictures. Much time can be wasted, as all successful photographers well know, searching the bypaths for an answer that lies along the main highway.

The characteristics of a perfect negative are:

(1) Maximum number of tones allowed by subject matter.
(2) Separation of tones to the maximum extent consistent with the type of subject.
(3) Density suited to the method of printing.
(4) Grain permitting the required degree of enlargement.

These characteristics are produced only by the proper correlation of lighting, film stock, exposure and development. To check your own procedures and take stock of your usable working knowledge (some photographers know their facts but do not put them into practice) quiz yourself on the following:

FILM STOCK

(1) How do you determine the relationship in which the subject tones are to be rendered? Do you select film stock according to a predetermined knowledge of the way it registers tones, or do you let the tones register as they will on the film that is on hand?
(2) Do you make use of the color sensitive properties of emulsions? Do you ever use film stock to emphasize or subdue dominant color tones according to the subject matter, or do you use panchromatic film on all subjects because sensitivity to all colors offhand makes it seem better for general use?
(3) Do you change film stock between long and short scale subjects?
(4) Do you use "Portrait Film" for portraiture, or do you let the method of lighting determine the film stock?

EXPOSURE

(5) Do you use a photoelectric cell exposure meter to measure light value or do you depend on experience and guess at the correct exposure?

(6) Do you arbitrarily use the readings of the meter or do you use these readings to guide you in determining the density of the negative?

(7) Do you use the meter on both ends of a long scale subject to determine which end of the tone scale is to be dropped?

DEVELOPMENT

(8) Do you believe that one certain developer is far superior to all others, or can you make any number of developers do your work?

(9) Do you develop according to some arbitrary time and temperature hoping that the tone ratio will represent the subject in a satisfactory manner, or do you develop with a predetermined idea of making the tone ratio greater, the same, or less than the subject?

LIGHTING

(10) Do you shoot outdoor scenes with whatever light happens to be around, or do you wait at times for the light to change?

(11) In studio work do you pattern your lighting set-up after some diagram or other, or have you worked out your own system of distance, angles, and intensities to register the complete tone gradation of any subject with your own equipment?

(12) Are you positive you can get maximum tone separation if you want it?

THE NEGATIVE FOR ENLARGING

While negatives for professional portrait, commercial work, or press photography each have their own special requirements, generally speaking they are made for contact printing. The production of a negative for enlarging which, when printed, will have "contact" quality is far more critical.

The latitude in the exposure of photographic film has been often demonstrated by exposing the average outdoor scene normally and making additional negatives with up to ten times normal exposure

and one-tenth normal exposure. The contact prints all look very much alike showing the great latitude that exists in exposure.*

This latitude, however, exists only in contact work. If these same negatives which give similar results when contact printed were all enlarged, some of the negatives would be unprintable and others, while printable, would not have "contact" quality. Only a few would enlarge properly. The latitude in negative making which is present when negatives are contact printed shrinks materially when negatives are produced for enlarging.

While there are many types of negatives which will give adequate contact prints, there is only one kind of negative which when enlarged will give full quality. This is a negative which, neither too thin nor too dense, is full bodied with all tones sharply distinguished. Such a negative permits enlargement up to the appearance of grain without losing sharpness or tone gradation. If too thin, it is underexposed. If too dense, it does not retain full quality on enlarging although it will give a satisfactory contact print. Figure 65 is a routine print from a proper negative.

The first factor in arriving at a standardized working procedure is development. Film stock is selected to go along with development and then lighting and exposure are standardized in their proper relationship. As the production of the negative for enlarging is so critical, the standardized procedure must be followed from beginning to end. There is no room for guesswork with subsequent manipulations, variations, and compensations in the dark room. When you work with enlarged prints, once the shutter is snapped, you have definitely determined whether the negative is as it should be. If wrong, reducers, intensifiers and other tricks will never make it right.

NEGATIVE DENSITY AND GAMMA

To most photographers negative density and contrast are like "Mike and Ike—they look alike." The terms are used interchangeably as if they were synonymous yet they are far removed in meaning.

Gamma, the much used word in photographic parlance, is still a Greek word to most photographers. It actually is a numerical symbol that describes the extent of development but often is associated with the visual density contrast or visual appearance of the negative.

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* (See "Photography" by Mees, page 104 plate 22)

Developed to a gamma of 1. (unity), a negative registers the tones in the same ratio as the subject. Development to less than unity registers the tones with a lesser ratio. Development to more than unity registers the tones with a larger ratio. Thus gamma is only a measure of tone separation between subject and negative.

Visually gamma cannot be seen. It is a scientific measurement. What you do see is visible tone contrast produced by density.

Negatives developed to a gamma of .8 have less tone contrast than the original subject. This is just a direct comparison between negative tones and subject tones. Negatives developed to a gamma of .8 will vary widely in visual appearance for the eye judges density contrasts only. It cannot make a comparison between tone separation of subject and negative. Dense negatives or thin negatives, contrasty negatives or soft negatives, all can be produced with like gammas.

So, thinking about development, it becomes obvious that the function of development is to register subject tones on the negative—in the same ratio—wider apart, or closer together. Density contrasts, heaviness or thinness, are not the products of development, although a film must be developed before these characteristics exist. Heaviness or thinness is produced by exposure and density contrasts are produced by the type of film.

Making all negatives enlarge properly regardless of the kind of subject is not as difficult as it may appear, provided each of the factors that influence negative quality is made to exert its influence at the proper time and not manipulated to compensate for guess work or errors. For example, developing a negative beyond what is necessary for the desired ratio of all tones on the negative will, of course, produce a heavier negative looking at it visually. But if the negative is thin to begin with the proper way to make it heavier is by exposure and not by juggling with tone ratios. Or, if the printing contrast of the negative is not correct for the type of subject, the way to correct this is in the use of proper film stock, not by manipulating development times.

There is no one film stock, one developer, nor one exposure system with which it is possible to always produce full quality negatives for enlarging. But by intelligent selection of various photographic

materials and understanding the different factors which influence negative quality, there is no reason why negatives of the highest quality cannot be produced every time a picture is taken.

Standardized procedure in producing negatives for enlarging requires that development be predetermined by the tone separation of the subject. Minimum full exposure is then keyed to this by using the highest Weston rating. This insures a thin but full bodied negative. Film stock is selected according to the work at hand, as a soft, medium or hard negative is wanted. It is when the functions that influence the negative are misused or overworked and allowed to wander around haphazardly that trouble begins. Expedients such as twice normal exposure will not compensate for soft negative stock, nor will longer developing time make up for lack of exposure. Such haphazard work will never produce negatives which will enlarge properly.

The making of a negative is greatly simplified if definite functions are assigned to each of the factors that effect negative quality.

(1) The function of lighting is, therefore, to separate the tones of the subject.

(2) The function of development is, therefore, to separate subject tones to a greater, lesser, or the same degree in the negative. (Gamma.)

(3) The function of film stock is, therefore, to record all of the subject tones in printable densities. (Density contrast.)

(4) The function of exposure is, therefore, to place the tones on the film using selected densities. (Heaviness or thinness.)

The following chapters will cover thoroughly each of these functions and if at all times each function is considered separately and apart from its obvious relation to the others, negative making is greatly simplified. Using development only as a control of the tone separation between subject and negative is a far easier approach than the usual juggling of development, trying to compensate and adjust for inaccuracies in the other factors that influence the negative.

Chapter Five

NEGATIVE DEVELOPMENT

Although films must be developed before they become negatives the characteristics of a good negative are only partially due to development. In a recent lecture a well known worker advised all photographers to double the reading of the exposure meter and halve the developing time. Another advocates a minimum of exposure with a developing time of an hour and one-half. Still other instructions come with films calling for development for a specific length of time at a certain temperature. What is the right time—the manufacturer's time, half this time, or an hour and one-half?

In addition to this confusion regarding the time of development, there is confusion as to the best methods of developing which are described in books and periodicals. There is development by inspection; by time and temperature; by dilution of the developer; by the factorial method; by the water bath system;* and by dividing the developer.** Confusion, confusion, and more confusion. There are an indefinite number of complicated ways to do an extremely simple, mechanical operation. Development becomes complicated only when its function is not clearly understood. Once it is decided to use development only to fix the ratios between tones of the subject and the negative, and not to determine visual negative contrast, development becomes an affair of minor importance in the life of any photographer.

* B. J. Almanac 1932, Page 181, Knapp System.
** Journal of the Society of Motion Picture Engineers, Vol. XXI, July, 1933, Page 21.

An exposed negative, placed in a developing solution, has been likened to an automobile race between many cars of large and small horsepower having various quantities of gasoline in their gas tanks. The race begins at the base of a wall and an observer, behind the wall, anxiously looks out over it waiting for the cars to come in view.

The first car to appear represents the first highlight tone of the subject. It is a high-powered car with a full gas tank. The last car to come into view is the lowest shadow tone of the subject. It is a car of small horsepower with very little gas in its tank. Between them are all the other cars of various horsepowers, some having full gas tanks, and others having tanks almost empty, representing all the half-tone values of the subject.

The observer can watch the race until all the cars are out of gas and the race is finished, or he can stop the race at any time before all cars have travelled as far as they might go. If the race is allowed to continue until all the entries have run out of gas, the maximum possible tone separation is achieved. Stopping the race at any point before this lessens the distance between all cars but in no way changes the cars around.

The tones of an exposed negative placed in a developing solution gain in density for a definite period of time only. Beyond this time there is no further development and fogging begins. The point of this maximum gain in tone separation is known as *gamma infinity* and it varies with each make of film and each developer. With some developers the period of fogging begins immediately after *gamma infinity* is reached. With others, particularly fine grain developers, fogging does not take place until several hours after development stops.

NEGATIVE TONE SEPARATION

The function of development is to control the ratio in which tones of the subject are separated in the negative. These tones cannot be changed around any more than the cars in the automobile race. The low-powered cars with small amounts of gas in their gas tanks are never going to forge ahead of the high-powered cars. The distance, however, between all cars can be altered depending on how long the race is allowed to run. If it continues for just a short time, the distance between cars will not be much but as the race goes on the distance separating all the cars in the race becomes greater.

When the tones of the subject are separated in exactly the same ratio on the negative as they are in the subject, the negative has been developed to a gamma of unity (1). When the tone separation of the negative is greater than the subject, the negative has been developed to a gamma of more than unity. When the ratio of tone separation is less on the negative than in the subject, the negative has been developed to a gamma of less than unity.

Therefore, when it is desired to record the tone ratios of the subject exactly as they are, development to a gamma value of 1. is always used. When the ratios are required to be less than in the subject, development is carried out to a gamma value of less than unity. Similarly when the ratios are required to be greater than in the subject, development to a gamma value of more than unity is used.

As the length of time in a developing solution determines the value of gamma, it becomes obvious that in working the photographic process for its finest points, the proper time of development is not the manufacturers' recommended time, half of this time, or an hour and one-half. The proper time is the time required to reach a selected value of gamma.

Conventional usage has assigned the following values of gamma for general work:

Type of Film	*Value of Gamma*
Aero	1.2
Commercial	1.0
Portrait	.9
Press	1.2
Miniature	.8
Amateur	1.0

The aero film and press film are developed to a gamma of 1.2 so that the tone ratios on the negative are greater than in the subject. In general, scenes in work of this kind are flat and lacking in tone contrast. As the rendering must be as bright as possible, the tone ratios are pulled farther apart than they actually are.

Commercial films and amateur films are developed to a gamma of 1. In general these scenes are of average contrast and the rendering of tone contrasts as they are is entirely satisfactory.

Portrait films are developed to a gamma of .9 so the tone ratios

Figure 33
Subject of Average Contrast. Negative Developed to Gamma .7.

Figure 34
Subject of Average Contrast. Negative Developed to Gamma .9.

Figure 35
Subject of Average Contrast. Negative Developed to Gamma 1.1.

are less than the subject. In the usual professional portraits spotlights brilliantly illuminate small portions of the face in great contrast to darker portions of the picture. To keep these contrasts within the reproduction range and also to soften the rendering of skin texture these tone ratios are kept less than the original subject. Miniature films are developed to a gamma of .8, but this is because grain is minimized at this point, not because of subject matter.

In practice the value of gamma which is selected for the development of any film should be determined by the contrast of the original subject rather than by grouping under types of work. Because one takes a portrait is no reason to arbitrarily develop the film to a gamma value of .9. Perhaps Hollywood spot and pattern lightings will not be used. Perhaps skin texture as in the Frontispiece is desired. It is far better to classify by subject contrast. Let the way in which the ratios of the subject tones are to be recorded determine the value of gamma. Subjects should be classified as follows:

Subject	*Develop to Gamma of*
Low Contrast	1.2, greater tone ratio
Average Contrast	1.0, same tone ratio
High Contrast	.8, lesser tone ratio

The keying of subject contrast and degree of development as-

Figure 36
Low Contrast Subject, Negative Developed to Gamma .8.

Figure 37
Low Contrast Subject, Negative Developed to Gamma 1.2.

Both Prints on Same Grade of Paper.

sumes a natural rendering of the subject which is required in almost all pictures. For special effects a high contrast subject might be developed to a high gamma (Fig. 39) or a low contrast subject to a low gamma. (Fig. 36.) These possible variations are easily made once the entire technique of negative making is thoroughly mastered and these special effects are, therefore, under complete control.

Figures 33, 34 and 35 show the appearance of negatives of average subject contrast developed to different gammas. There will be difficulty in getting a good print from a negative such as Fig. 33 but it can be done. Fig. 34 will make an excellent enlargement. Fig. 35 will print but will require a soft paper. Thus with average subject contrasts development does not have to be critical.

The importance of selecting the proper gamma for development when dealing with subject matter of other than average contrast cannot be over-estimated. Figures 36 and 37 show a low contrast

Figure 38
High Contrast Subject. Negative Developed to Gamma .8.

Figure 39
High Contrast Subject. Negative Developed to Gamma 1.2.

Both Prints on Same Grade of Paper.

subject with negatives developed to gamma .8 and gamma 1.2. There are times when the effect of Fig. 36 might be desirable but in most cases rendition as in Fig. 37 is required.

Figures 38 and 39 show a high contrast subject with negatives developed to gamma .8 and gamma 1.2. In Fig. 39 the plaster head has gone black and the detail in the glass brick higher up has not come in. The effect is a silhouette. In Fig. 38 there is detail in the glass brick all the way to the top and the plaster head is in deep shadow with detail still visible. The effect of Fig. 39 might be desirable in some instances but most of the time the full tone rendition of Fig. 38 is required.

CLASSIFICATION OF SUBJECTS

The following classification of subject matter into low, average and high contrast groups will prove helpful. The same subject can undergo extensive alterations in contrast under different lighting conditions:

Low Contrast	*Average Contrast*	*High Contrast*
Open Landscapes	Sunlit landscapes with foreground objects	Interiors generally
		Pattern lightings
Outdoor scenes on dull days	Street Scenes	Snow scenes with important dark objects
Coscups for detail	All scenes which definitely do not fit in high or low contrast classifications.	Subjects through archways, windows, doors
Distant Views	Portraits lighted as in Chapter Eight	Subjectsincludingboth indoors and outdoors

TIME AND GAMMA TABLES

The time-gamma tables of various films with the manufacturers' recommended developer are not always available. Some of the information for the most popular films has been assembled. If the tables do not give films or developers which are preferred, the service departments of the film manufacturers will give this information.*

The time for various values of gamma must be determined in the laboratory of the film manufacturer. The time changes for different developers. When a manufacturer recommends a developer for use with a particular film, many practical considerations such as effective emulsion speed, fog value, and keeping qualities have determined the recommendation.

A gamma of unity is a gamma of unity whether with metol, pyro, hydroquinone, or glycin. The developing time required to get a given value of gamma will vary with different developers but once it is reached the tones on the negative will be in the same ratios as in the subject with any developer. The factors of density and negative tone scale are controlled by exposure and selection of negative stock. It, therefore, becomes obvious that the best procedure for development is to use the manufacturer's recommended developer with his time-gamma tables. Changing to other developers complicates the procedure by adding unknown factors and can produce no better results.

Accepting this method of developing immediately clears away the confusion regarding the various other developing systems such as inspection, factorial, dilution, etc. The manufacturers all base

* Readers must realize that a manufacturer can only furnish Time-Gamma information for his own films when developed in the formula which he recommends for the film.

their gamma tables on time and temperature development. Hence, no other system can be accurately used. As a matter of fact all the other systems of developing are gradually disappearing. No other method approaches the results that can be obtained by developing to a selected gamma according to subject contrast.

NOTES ON THE TIME-GAMMA TABLES

The Weston Ratings are based on maximum film speed with the particular developer recommended. The developer used has a profound effect on effective film speed and must be taken into consideration. If a denser negative is required use a lens opening ½ stop larger than the indicated exposure.

Maximum development, that is development to gamma infinity is not often used in normal photographic work because the quality of the photographic images usually suffers.

The Weston Maximum Speed Ratings are based on development to gamma .8 for miniature film, gamma .9 for portrait film, gamma 1. for amateur and commercial film, gamma 1.2 for press film and gamma 3. for process film with the specified developers. If other developers or other gammas are used the ratings may vary accordingly.

Almost all time-gamma information is based on developing at 65°F. Room temperatures are usually higher. When ready to develop always take the temperature of the developer. Assume that a rise of 10°F. will cut the developing time in half. Therefore, with each rise of 1°F. above 65°F. decrease the developing time 5%.

For example, if the time is 10 minutes at 65° use 8½ minutes at 68°F, 7½ minutes at 70°, 5 minutes at 75°F. The temperature compensation is not absolutely accurate but is close enough for practical use.

Time—Gamma Table

AGFA	Maximum Weston Speed Rating		Developer Formula	Developer Temperature	Value of Gamma						
	Daylight	Mazda			.7	.8	.9	1.	1.1	1.2	1.3
					Time in Minutes						
1. Miniature Films											
Fine Grain Plenachrome	32	20	Agfa 17	65°	8	10	12	16			
Finopan................	24	16	Agfa 17	65°		7	9	12	14		
Superpan Supreme......	64	40	Agfa 17	65°	8½	10	12	14			
Ultra Speed Pan.........	125	80	Agfa 17	65°	14	18					
2. Rolls and Packs											
Standard................	16	5	Agfa 47	65°		4½	6	8			
Plenachrome............	32	20	Agfa 47	65°		4	5	7	8		
Super Plenachrome......	64	40	Agfa 47	65°		4	5½	8			
Finopan................	24	16	Agfa 47	65°				5	6	7	8
Superpan Supreme......	64	40	Agfa 47	65°			4½	6	9		
Superpan Press..........	125	80	Agfa 47	65°		4	5	6	8		
3. Cut Film											
Super Sensitive Pan.....	50	32	D-1 Pyro Tank	65°			6	8	10		
			D-1 Pyro Tray	65°				4½	5½		
			Agfa 47 Tank	65°	6	8	12	14			
			Agfa 47 Tray	65°	4	5	6	8	10		
Super Pan Portrait......	32	20	D-1 Pyro Tank	65°			7	8	10	12	14
			D-1 Pyro Tray	65°			4	5	6	8	10
			Agfa 47 Tank	65°			8	10	12		
			Agfa 47 Tray	65°				5	6	8	
Iso Pan.................	64	40	Agfa 17 Tank	65°	9	12	16	20			
			Agfa 47 Tray	65°			5	8			
			Agfa 47 Tank	65°			8	12			
Supersensitive Plenachrome..........	64	20	D-1 Tray	65°		4	6	9			
			D-1 Tank	65°	6	7	9	12			
			Agfa 47 Tray	65°	4	5	8	10			
			Agfa 47 Tank	65°	7	9	12	18			
Triple S Pan............	125	80	Agfa 47	65°	4	6	10				
Superpan Press..........	125	80	Agfa 47	65°	4	5	7	10			

FORMULAS LISTED IN GAMMA INFINITY TABLES

D-1 PYRO

	Stock Solutions	*Avoirdupois*		*Metric*	
A.	Sodium Bisulphite	140	grains	9.8	grams
	Pyro	2	ounces	60	grams
	Potassium Bromide	16	grains	1.1	grams
	Water to make	32	ounces	1	liter
B.	Sodium Sulphite	3½	ounces	105	grams
	Water to make	32	ounces	1	liter
C.	Sodium Carbonate	2½	ounces	75	grams
	Water to make	32	ounces	1	liter

For a half-gallon tank take four and one-half ounces (143 cc.) each A, B and C and add distilled water to make a half-gallon. (2 liters.) Use only once and then discard.

D-76

	Avoirdupois	*Metric*
Metol (Elon)	116 grains	8 grams
Sodium Sulphite	13 ounces	400 grams
Hydroquinone	290 grains	20 grams
Borax	115 grains	8 grams
Water to make	1 gallon	4 liters

Use distilled water. Can be kept in a tank and replenished. Filter before using, as sludge forms.

D-76 REPLENISHER

		Avoirdupois		*Metric*
Metol (Elon)		175	grains	12 grams
Sodium Sulphite		13¼	ounces	400 grams
Hydroquinone		1	ounce	30 grams
Borax	2 oz.	290	grains	80 grams
Water to make		1	gallon	4 liters

Use Replenisher solution without dilution and add to tank to maintain the level of the solution.

D-19

		Avoirdupois	*Metric*
Water (125° F.)		64 ounces	2.0 liters
Elon		128 grains	8.8 grams
Sodium Sulphite	12 oz.	360 grains	384.0 grams
Hydroquinone	1 oz.	75 grains	35.2 grams
Sodium Carbonate	6 oz.	180 grains	192.0 grams
Potassium Bromide		290 grains	20.0 grams
Cold water to make		1 gallon	4.0 liters

Use without dilution.

DK-20

	Avoirdupois	Metric
Water (125° F.)	60 oz.	750.0 cc.
Elon	175 grains	5.0 grams
Sodium Sulphite, anhydrous	8 oz.	100.0 grams
Kodalk	70 grains	2.0 grams
Potassium sulphocyanide (thiocyanate)	35 grains	1.0 grams
Potassium bromide	18 grains	0.5 grams
Cold water to make	80 oz.	1.0 liter

DK-20 REPLENISHER

	Avoirdupois	Metric
Water (125° F.)	60 oz.	750.0 cc.
Elon	265 grains	7.5 grams
Sodium sulphite, anhydrous	8 oz.	100.0 grams
Kodalk	1 oz. 260 grains	20.0 grams
Potassium sulphocyanide (thiocyanate)	175 grains	5.0 grams
Potassium bromide	35 grains	1.0 grams
Cold water to make	80 oz.	1.0 liter

DK-50

	Avoirdupois	Metric
Water (125° F.)	64 ounces	2.0 liters
Elon	145 grains	10.0 grams
Sodium Sulphite	4 ounces	120.0 grams
Hydroquinone	145 grains	10.0 grams
Kodalk	1 oz. 145 grains	40.0 grams
Potassium bromide	29 grains	2.0 grams
Cold water to make	1 gallon	4.0 liters

For tank, take 1 part stock solution and 1 part water.

DK-50 REPLENISHER

	Avoirdupois	Metric
Water (125° F.)	96 ounces	3.0 liters
Elon	290 grains	20.0 grams
Sodium Sulphite	4 ounces	120.0 grams
Hydroquinone	1 oz. 145 grains	40.0 grams
Kodalk	5¼ ounces	160.0 grams
Cold water to make	1 gallon	4.0 liters

Dilute 1 part Stock Solution with 1 part water and add to the tank as needed to maintain the level of the solution.

FORMULAS LISTED IN GAMMA INFINITY TABLES

D-1 PYRO

Stock Solutions	*Avoirdupois*	*Metric*
A. Sodium Bisulphite	140 grains	9.8 grams
Pyro	2 ounces	60 grams
Potassium Bromide	16 grains	1.1 grams
Water to make	32 ounces	1 liter
B. Sodium Sulphite	3½ ounces	105 grams
Water to make	32 ounces	1 liter
C. Sodium Carbonate	2½ ounces	75 grams
Water to make	32 ounces	1 liter

For a half-gallon tank take four and one-half ounces (143 cc.) each A, B and C and add distilled water to make a half-gallon. (2 liters.) Use only once and then discard.

D-76

	Avoirdupois	*Metric*
Metol (Elon)	116 grains	8 grams
Sodium Sulphite	13 ounces	400 grams
Hydroquinone	290 grains	20 grams
Borax	115 grains	8 grams
Water to make	1 gallon	4 liters

Use distilled water. Can be kept in a tank and replenished. Filter before using, as sludge forms.

D-76 REPLENISHER

		Avoirdupois	*Metric*
Metol (Elon)		175 grains	12 grams
Sodium Sulphite		13¼ ounces	400 grams
Hydroquinone		1 ounce	30 grams
Borax	2 oz.	290 grains	80 grams
Water to make		1 gallon	4 liters

Use Replenisher solution without dilution and add to tank to maintain the level of the solution.

D-19

		Avoirdupois	*Metric*
Water (125° F.)		64 ounces	2.0 liters
Elon		128 grains	8.8 grams
Sodium Sulphite	12 oz.	360 grains	384.0 grams
Hydroquinone	1 oz.	75 grains	35.2 grams
Sodium Carbonate	6 oz.	180 grains	192.0 grams
Potassium Bromide		290 grains	20.0 grams
Cold water to make		1 gallon	4.0 liters

Use without dilution.

DK-20

	Avoirdupois	Metric
Water (125° F.)	60 oz.	750.0 cc.
Elon	175 grains	5.0 grams
Sodium Sulphite, anhydrous	8 oz.	100.0 grams
Kodalk	70 grains	2.0 grams
Potassium sulphocyanide (thiocyanate)	35 grains	1.0 grams
Potassium bromide	18 grains	0.5 grams
Cold water to make	80 oz.	1.0 liter

DK-20 REPLENISHER

	Avoirdupois	Metric
Water (125° F.)	60 oz.	750.0 cc.
Elon	265 grains	7.5 grams
Sodium sulphite, anhydrous	8 oz.	100.0 grams
Kodalk	1 oz. 260 grains	20.0 grams
Potassium sulphocyanide (thiocyanate)	175 grains	5.0 grams
Potassium bromide	35 grains	1.0 grams
Cold water to make	80 oz.	1.0 liter

DK-50

	Avoirdupois	Metric
Water (125° F.)	64 ounces	2.0 liters
Elon	145 grains	10.0 grams
Sodium Sulphite	4 ounces	120.0 grams
Hydroquinone	145 grains	10.0 grams
Kodalk	1 oz. 145 grains	40.0 grams
Potassium bromide	29 grains	2.0 grams
Cold water to make	1 gallon	4.0 liters

For tank, take 1 part stock solution and 1 part water.

DK-50 REPLENISHER

	Avoirdupois	Metric
Water (125° F.)	96 ounces	3.0 liters
Elon	290 grains	20.0 grams
Sodium Sulphite	4 ounces	120.0 grams
Hydroquinone	1 oz. 145 grains	40.0 grams
Kodalk	5¼ ounces	160.0 grams
Cold water to make	1 gallon	4.0 liters

Dilute 1 part Stock Solution with 1 part water and add to the tank as needed to maintain the level of the solution.

DK-60A

		Avoirdupois	Metric
Water (125° F.)		96 ounces	3.0 liters
Elon		145 grains	10.0 grams
Sodium Sulphite	6 oz.	290 grains	200.0 grams
Hydroquinone		145 grains	10.0 grams
Kodalk	2 oz.	290 grains	80.0 grams
Potassium Bromide		29 grains	2.0 grams
Cold water to make		1 gallon	4.0 liters

Use without dilution.

D-72

See page 159. For negatives use 1:1.

AGFA-17

		Avoirdupois	Metric
Hot Water (125° F.)		24 ounces	750 cc.
Metol		22 grains	1.5 grams
Sodium Sulphite, anhydrous	2½ oz.	80 grains	80 grams
Hydroquinone		45 grains	3 grams
Borax		45 grains	3 grams
Potassium Bromide		7.5 grains	.5 grams
Water to make		32 ounces	1 liter

AGFA-47

	Avoirdupois	Metric
Hot Water (125° F.)	24 ounces	750 cc.
Metol	22 grains	1.5 grams
Sodium Sulphite, anhydrous	1½ ounces	45 grams
Sodium Bisulphite	15 grains	1 gram
Hydroquinone	45 grains	3 grams
Sodium Carbonate, monohydrated	88 grains	6 grams
Potassium Bromide	12 grains	.8 gram
Water to make	32 ounces	1 liter

ND-2

	Avoirdupois	Metric
Water	125 fl. ozs,	975.0 ccs.
Rhodol, (Metol or Elon)	146 grains	2.5 grams
Sodium Sulphite, anhydrous	10 oz.	75.0 grams
Hydroquinone	175 grains	3.0 grams
Borax	292 grains	5.0 grams
This makes final volume	1 gallon	1.0 liter

ND-3

		Avoirdupois	Metric
Water (125° F.)		125 fl. oz.	975.0 ccs.
Sodium Sulphite, anhydrous		12 oz.	90.0 grams
Paraphenylenediamine	1 oz.	146 grains	10.0 grams
Glycin		117 grains	2.0 grams
This makes final volume		1 gallon	1.0 liter

ND-4

		Avoirdupois	Metric
Water		125 fl. oz.	985.0 ccs.
Rhodol (Metol or Elon)		23 grains	0.40 grams
Sodium Sulphite, anhydrous	6 oz.	290 grains	50.0 grams
Hydroquinone		131 grains	2.25 grams
Borax		73 grains	1.25 grams
Citric Acid		23 grains	0.40 grams
This makes final volume		1 gallon	1.0 liter

DEVELOPING ROLL FILMS

A roll of film must be developed to one gamma value. It is impossible to vary the developing time of different portions of the film according to the subject matter. It is equally impossible to get maximum quality in pictures taking scenes of high, low and average contrast and developing them all alike. The only answer to this dilemma is to have two cameras.

The reflex with its individual film holders can be used on high or low contrast scenes and the roll film camera can be used on scenes of average contrast. If two cameras are not available it is best to avoid scenes of high or low contrast, unless a complete roll is used on these special subjects. If one roll contains scenes of various contrasts develop to gamma .9 as a compromise.

FINE GRAIN DEVELOPMENT

Under the table giving the conventional values of gamma for various types of film (Page 61) miniature negatives are developed to a gamma of .8. Here the most important factor supposedly is the greatest freedom from grain so that the maximum degree of enlargement can be obtained. The greatest freedom from grain will be secured by using film stock stated by the manufacturer to be fine

grained, developed in a fine grain developer, to a gamma of .8.*

Obviously here is another dilemma. Which is most important—controlling the ratio of subject tones to negative tones or getting the utmost possible fineness of grain? What can be done depends on the degree of enlargement required. The worker requiring an 11x14 print from half a 35 mm. frame is in a much tougher spot than another miniature worker requiring an 11x14 print from all of a 2¼x2¼ negative.

The object of the photographer is the production of pictures, not the striving to enlarge a small portion of a motion picture size negative to the greatest extent. If a negative does not enlarge to the required extent, it does not call for six months experimentation with all known fine grain developers. It means either learning to make negatives using all the available film area or, if this is still unsatisfactory, going to a larger negative size. The possibilities of enlarging cannot be overworked and the prospect of extreme enlargement must never overshadow the necessary negative quality for fine pictures.

As the film itself has much more to do with the fineness of grain than the developer, it is often possible to develop to higher gamma than .8 and not run into too much grain. It, of course, depends on the negative area used and the size of the final print. For maximum enlargement a gamma of .8 must be adopted and low contrast subjects avoided, but that is not often necessary. Figure 40 is from a 14x17 print made from a 2¼x2¼ negative using all the picture area. The film was Verichrome developed to a gamma of 1.1 in D-76. There is no grain in the print.

In discussing miniature procedure what must be done depends entirely on how much enlargement is necessary. Do not overwork the possibilities and expect the impossible. It is no longer necessary to go into the field with an 8x10 camera but it also does not follow that a 35mm. film size will be a perfect substitute in all cases.

DEVELOPING EXTREMELY LONG SCALE SUBJECTS

Development to a gamma of .8 is recommended for subjects of high contrast but there are some scenes encountered which have

* The Maintenance of Negative Quality.—J. I. Crabtree, Kodak Research Laboratories, Rochester, N. Y.

"Ebb Tide" *Paul Louis Hexter, A.R.P.S.*

Figure 40. The original print was enlarged to 14 x 17" from a 2¼ x 2¼" Verichrome negative developed in D-76 to gamma 1.1. No grain is apparent but the author acknowledges that the reproduction does not offer proof of that since the reduction in size also reduces visible grain.

Figure 41
High Contrast Subject. Negative Developed to Gamma .8.

Figure 42
High Contrast Subject. Negative Developed in Cut-back Pyro.

Both Prints on Same Grade of Paper.

such great contrasts that this development will not give satisfactory negatives. There are also scenes where a small portion of the picture area is a concentrated spot of intense light and halation must be avoided.

Scenes of such great contrasts might be encountered in a deep forest with sunlight filtering through the leaves and most of the picture in deep shadow; or in photographing the pouring of molten metal in a steel mill. Great contrasts and trouble with halation are always encountered when photographing interiors and exteriors at the same time, as in an interior looking out on a garden.

The remedy is to use the regular D-1 Pyro formula (Page 70) with only one-third the carbonate content. Ordinarily this developer works through the entire thickness of the film. By cutting the carbonate, its action is confined in large part to the surface. Thus the powerful highlight tones do not develop out to the fullest extent whereas the weaker shadow tones do.

Figure 43
Halation. Negative Made on Non-Backed Plate Developed to Gamma .8.

Figure 44
No Halation. Negative Made on Film with Antihalation Backing Developed in Cut-back Pyro.

When scenes of excessive contrast are encountered, or scenes where halation is expected, develop in D-1 Pyro tank dilution, the carbonate content cut to one-third, and the time increased by three. For most films this would be from 30-40 minutes at 65°.

Figures 41 and 42 show the difference in a long scale subject developed normally and in cut-back pyro. Notice the outdoors is visible in Fig. 42. Figures 43 and 44 show the value of cut-back pyro and anti-halation film in overcoming halation.

While the cut-back Pyro method has been used on long scale subjects for many years, a new technique has recently been developed, the P & H Process, which handles long scale subjects better than any previous method. As a matter of fact the P & H Process gives a marked increase in emulsion speed and enables shadow detail to build up to a considerable extent without blocking up the highlights. Even in the case of subjects which are not particularly long scale, it has much merit.

The process is quite simple. The film is immersed in a developer,

containing no bromide, for a long enough period to thoroughly saturate the film, but a short enough time so that little development takes place during this period. This is from 45 seconds to 1½ minutes depending on the film.

Then the film is squeegeed, emulsion face down, on a piece of clean glass with a *soft* squeegee. The action should be gentle. (Hard squeegees cause streaked films.) The glass and film are laid in a tray of water at 70° for 15 minutes. The water has nothing to do with the development. It is the way of securing the proper developing temperature. Development proceeds to completion within the 15 minutes and the film is then fixed in the usual way.

As the film is immersed in the developer for only long enough to saturate the emulsion, little development takes place until the film has been squeegeed to the glass and immersed in water. The highlight tones come out first. As they develop vigorously they release quantities of potassium bromide which act as a restrainer and limit development in the highlights. When the developer saturating the film around a highlight tone is used up development ceases.

In the shadow tones development proceeds slowly with little potassium bromide being released, and smaller quantities of developer being used. Therefore, the shadow tones, being more free from restraining action and using up the available developer more slowly actually develop further than with ordinary developing procedures. When all the developer is used up action ceases.

The only disadvantage to the process is that special apparatus is required for processing roll film or any quantity of cut film. A few cut films at a time can be easily handled with just a squeegee and a piece of glass.

DEVELOPING PROCEDURE

In making up all negative developing formulas, it is absolutely necessary to use distilled water for both stock solution and dilution. When cut films are developed it is important to have the developing tank of ample size so the developer has free access to each negative. Do not crowd too many hangers into the tank. It is preferable to get a larger tank.

In preparation for developing, films are best put on cut film hangers or roll film reels in absolute darkness. The safeness of a safe light is entirely relative and the best way to prevent light from affecting the film is not to use it. If an open cut film tank is used, it can be covered with an old hat box and the light turned on.

On placing films in an open cut film tank, it is best to raise and lower each hanger several times to prevent air bells from clinging to the surface of the films. Twirling the reel of a roll film tank does the same. The film must be agitated during development to secure evenly developed negatives. With cut film, this is accomplished by removing the cover from the tank and raising and lowering each developing hanger several times. With roll film it is accomplished by twirling the reel several times. It is good practice to divide the total time of development into five equal intervals, agitating at each one.

When development is completed, the films are rinsed in tap water somewhat near the temperature of the developer and placed in the fixing bath. The following fixing formula is entirely clean working, forms no scum, and has a long working life.

FIXING BATH

	Avoirdupois		*Metric*
Water	40	ounces	1200 cc.
Hypo	16	ounces	480 grams
Sodium Sulphite	1	ounce	30 grams
Acetic Acid	3	fluid oz.	96 cc.
Boric Acid crystals	½	ounce	15 grams
Potassium Alum	1	ounce	30 grams
Water to make	64	ounces	2 liters

Immerse double the time required for the films to fix out. Use a fresh solution when films do not fix out in 6 minutes. Do not use on prints.

After fixation is complete the films are well washed in water of approximately the same temperature as the other solutions. A mixer faucet in the darkroom, giving both hot and cold water at the same outlet, is the easiest way in which to regulate the temperature of the wash water.

The films are hung up to dry some place that is free from dust

and at the same time permits free circuation of air. Allow excess water to drip from the films for three minutes and then remove all water drops with a viscose sponge sandwich. This will prevent drying marks which sometimes spot films if they are not carefully wiped.

TESTING NEW DEVELOPERS

Most photographers are addicted to the vice of continuously experimenting with new or different developers, searching for some magic formula with which to create masterpieces. A few definitely like the fun of playing with something new and different. The purpose of including so much specific information on recommended developers is to make much experimenting unnecessary. These are the recommendations of the finest laboratories and are used by the finest technicians in the world.

For those who will still experiment beyond this, a word of caution. Do not heedlessly switch from one tried and proven developer to that recommended by a fellow amateur without making these few fundamental simple tests. Then if you are satisfied it is an improvement, use it by all means. Comparison at all times to a present standard developer must be the basis of all tests. The following simple tests are easily made:

(a) *Influence of Developer on Emulsion Speed*

To test the effect of a new developer on emulsion speed, make a series of step exposures to a weak light source, cut the film in half, develop one-half in the standard developer and the other half in the new developer. Wash, fix, and dry. Then place the two halves together and compare densities.

A convenient way to make this test is to load a $3\frac{1}{4} \times 4\frac{1}{4}$ cut film holder. As a light source use an ordinary flashlight with the light diffused with one layer of tissue paper. Place the film holder 20 feet from the light source in a room in which there is no stray light. Your living room at night with the shades down and the door closed will be satisfactory.

In the dark withdraw the slide in the film holder so that only $\frac{1}{2}$ inch of film is covered. This portion will not be exposed. Set the holder upright on a table so it is

perpendicular to the light source. Have an assistant turn on the light and give step exposures of 1, 2, 4, 8, 16 and 32 seconds. This is done by counting the seconds out loud and moving the slide down ½ inch on the proper counts.

After the exposure, cut the film in half and develop one-half in your standard developer, the other half in the new developer. When the two strips have been fixed, washed and dried, a comparison of densities will show the effect of the developer on emulsion speed. Using two separate films and attempting to duplicate exposures, or using negative exposed on an ordinary scene will not give an accurate comparison.

(b) *Fineness of Grain*

Make an exposure of an outdoor scene including clouds. This kind of scene is more apt to produce a grain because of dense highlight deposits than just any scene. Cut the film in half and develop one-half in your standard developer, the other in the new developer.

Put both halves together in the enlarger and make a big enlargement of part of the negative including both clouds and foreground. The print will tell you if there is any difference in grain.

(c) *Fog*

Examine the unexposed rabbet on the edge of each half of the film with a magnifying glass, against a strong light and compare the fog.

(d) *Gradation Qualities*

Expose two negatives on a very long scale subject. Develop one in the standard developer, the other in the new developer. After fixing, washing and drying, go over each negative with a magnifying glass comparing gradation and tone separation in both the highest lights and the deepest shadows.

(e) *Developing Time*

If the correct developing time of the new developer is

not known, make four duplicate exposures of an average scene such as your home on a sunshiny day. Develop one negative properly in your standard developer. Use the same time on the new developer but develop one negative for three minutes less and one for three minutes more. Usually one of the three negatives will closely approximate the contrast of the standard negative. If it is not exact, it will give an indication of which way to proceed and four more negatives should be made, the control negative again developed as a standard and the proper time determined from one of the other three, compared to your known standard.

EXPERIMENTS IN DEVELOPING

One hears so much about negative developers and their importance that it becomes imperative to establish beyond all question of doubt exactly how much importance should be attached to the entire subject. How much effect does development really have on any picture? Will a minute more create a masterpiece?

1. Make three identical exposures of a subject of average contrast such as your own house on a sunshiny day. Use double coated orthochromatic film such as Verichrome or Plenachrome. Develop one negative to a gamma of .8, one to 1.0 and one to 1.2.
2. Make three identical exposures of a subject of low contrast on commercial film such as Eastman Commercial Ortho or Agfa Super Sensitive Plenachrome. This could be your own house again but on a dull cloudy day. Develop to a gamma of .8, 1.0 and 1.2.
3. Make two identical exposures of a subject of high contrast on portrait film such as Eastman Par Speed Portrait or Defender Portrait. Develop to a gamma of .8 and 1.0.

Not all the negatives produced above will give good prints. By varying the contrast of the printing paper some can be properly printed. In the first set on amateur film, negatives are developed to gammas .8, 1., 1.2. Can all three negatives be made to give good prints if paper contrast is varied?

In the second set?

In the third set?

Answer the following questions:

(a) What has most to do with the contrast of a negative, development or negative stock?

(b) On what type of film does varying development show most change in visual contrast or are all types affected to the same degree? Is this contrast because of development or because of negative stock?

(c) If a dull subject is taken on film such as Verichrome or Plenachrome, can a brilliant negative be made by manipulating development?

The answers to these questions are apparent if one makes the experiments.

4. Make six exposures of an extremely long scale subject such as a combination indoor and outdoor scene. Two exposures should be on a non-backed plate, two on a non-backed film and two on a film with an anti-halation coating. The films and plates should all be the type recommended for portraiture.

   Develop a plate, non-backed film, and anti-halation film to gamma .8 and develop the others in cut-back Pyro (Page 76).

   1. Does the cut-back Pyro help all three to the same degree?
   2. Is there enough difference between the negatives made on film with the anti-halation coating to warrant this special treatment?
   3. In an extremely long scale subject, which is most important, development or film stock?

   After making these experiments, which are absolutely necessary to the proper evalution of the photographic process, answer the questions: "How Important Is Development? Will a Minute More Create a Masterpiece?"

5. With a new developing formula, one that from hearsay is supposedly pretty good, make all the experiments under Testing New Developers, Page 80, comparing to your standard developer.

Chapter Six

SELECTION OF NEGATIVE STOCK

Negative stock is just as much a factor in producing perfect negatives as are correct exposure and proper development, but of all the factors in negative making it receives the least attention. Just as there is no one developer that develops far better than any other, there is no one film stock that registers all tones better than any other. But there are certain film stocks which for given scenes will register the tones far better than others. Where is the photographer who has not taken a delightful distant vista only to find the film recorded little of what he saw and the picture was a dismal failure. Selection of proper negative stock has far more to do with fine pictures than developers and developing methods.

Films differ in contrast, color sensitivity, and speed. With the technical advances in the last few years, speed is no longer a primary consideration. Fast films work with no loss of quality; a fact which was not true in the past. Ultra-speed emulsions should not be used if the minimum amount of grain is required for maximum enlarging. Otherwise fast films are entirely satisfactory and allow the use of smaller stops which, most of the time, is a distinct advantage. Today, the determining factors in the selection of film stock are contrast and color sensitivity.

NEGATIVE TONE SEPARATION

When a negative is developed to a gamma of unity, the ratio of

tone separation is the same between negative and subject. Suppose a series of light intensities are recorded such as

1   2   4   8   16

This is a geometrical progression. Each number is multiplied by the same factor, in this case 2. An arithmetical progression is where the same factor is added instead of multiplied. Here it would be 1, 3, 5, 7, 9.

The eye recognizes light intensities only in geometrical progression. Take a cluster of ten light bulbs, for example. Add another bulb and you will see no difference in brightness. Double the number of bulbs and you will see twice as much light.

Now in depositing silver on the negative representing light intensities, it is necessary only that every step in the progression be represented by an equal increase in the amount of silver deposited. Thus light intensities 1 2 4 8 16 (geometrical progression) could be represented by silver densities .5 .6 .7 .8 .9 (arithmetical progression) or they could be represented by silver densities .5 .7 .9 1.1 1.3.

The ratios between subject tones and negative tones in both cases are still the same. Two negatives on different film stocks can have the same tone ratios as the subject but visually have entirely different contrasts. Refer to the negatives made in the experiments on development. Negatives on amateur and commercial film were both developed to a gamma of unity. The commercial film has much more contrast visually.

The ratio of tones between subject and negative is determined by development. The spacing of tones is determined by film stock itself. Negative tones can be in the same ratio as subject tones but can have greater or lesser differences between them without interfering with the subject to negative tone ratio. Two ladders can have 12 rungs each but the rungs can be a foot apart in one case and only six inches apart in the other.

CONTRAST AND THE SELECTION OF NEGATIVE STOCK

All films do not record the same range of light values. A portrait film will record a range of 1-256. The average amateur films record 1-128. By amateur film is meant the double coated orthochromatic

"chrome" film, such as Eastman Verichrome or Agfa Plenachrome. Press films probably average 1-90, commercial films 1-45, and process films 1-20. Thus there is a great difference in the number of tones which different types of film are able to record.

Suppose a film is represented by a rubber band just long enough to accommodate 90 pins right next to each other. The pins are then put in place and the band stretched one-third its length. There is room for 30 more pins and the band will now hold 120 pins. There is no more rubber in the band than originally but the amount of rubber for each individual pin is less.

If the band is then stretched double this length, twice the number of pins can be used. Now the band will hold 240 pins. The amount of rubber in the band is still the same as it was originally but the amount holding each individual pin is much less.

Press film is represented by the 90 pins. Amateur film is represented by the 120 pins and portrait film is represented by the 240 pins. As the difference is in the amount of rubber apportioned between pins, so the difference between the films is in the amount of silver apportioned between tones.

Portrait film registering a tone range of 1-256 records the greatest range of tones with the least amount of difference between each tone. It has a long scale and soft contrast. Amateur films register a tone range of 1-128. These films do not have the long scale of portrait film. They have a normal scale and greater contrast. Press films register a tone range of 1-90 which is a shorter scale of tones but with more difference between them. Commercial films with a ratio of 1-45 have a still shorter scale and higher contrast, and process films with a scale of 1-20 have the shortest scale and highest contrast.

A long scale film records many tones with smaller differences or contrasts between them. A short scale film registers fewer tones with greater differences or contrasts between them.

The amount of silver that a film deposits between tones for a given degree of development determines the scale and contrast and it is a characteristic of the film fixed at the time of manufacture.

If a subject of low contrast, for example a distant view, is photographed on a long scale film, such as portrait film, there is little separation between tones in the subject itself and minimum separation on the film stock. Development cannot exaggerate tone differ-

ences sufficiently to make a printable picture with such a negative.

It becomes obvious that long scale subjects should be photographed on long scale film and short scale subjects on short scale film.

Suppose a subject of very short tone range is photographed on commercial, amateur and portrait film and all negatives are developed to a gamma of 1. The ratio between subject tones and negative tones will be the same on all three negatives but the separation between tones for printing will be greatest on the commercial film and least on the portrait film. The commercial film is the only one that will give a good print of such a subject.

The separation on the portrait film while in the same ratio as the subject is such that there is little difference between tones. The negative will be too flat to print properly. The differentiation between tones is greater on amateur film and the negative will give a better print than the portrait negative. The commercial negative with the widest tone separation will give the best print. Bear in mind the subject is of low contrast. The important point is that tone ratios between subject and negative can be the same although the amount of silver between steps can be different giving widely different prints.

Practical procedure is to use long scale film (portrait) on subjects of high contrast; medium scale film (press and amateur) on subjects with normal contrasts; and short scale film (commercial) on subjects of low contrast so that all the tones are separated to give the best prints.

TABLE FOR FILM SELECTION AND DEVELOPMENT ACCORDING TO SUBJECT CONTRAST

Subject	*Film*	*Degree of Development*
Low Contrast	Commercial Short scale Gives higher printing contrast	Gamma 1.2 Greater tone separation than subject.
Normal Contrast	Press or Amateur Medium scale Average printing contrast	Gamma of 1. Same tone separation as subject.
High Contrast	Portrait Long scale Gives lower printing contrast	Gamma .8 Lesser tone separation than subject.

A very broad indication of the scale of a film is given by the highest recommended value of gamma to which it should be developed. If according to the Time-Gamma Tables (Pages 67-69) a film develops to a gamma of .8, or .9, it is a long scale film. If it develops to a gamma of 1. or 1.1, it is a medium scale film. If it develops to 1.2 or higher it is a short scale film. This is a very general classification and can be used when the manufacturer does not indicate the classification.

Figure 45 shows an average subject taken on portrait film. This negative would give a good print on contrast paper. If, however, the negative had been made on a dull day which would have made the subject one of low contrast it would not be usable.

Figure 46 shows the same subject on amateur film giving a good print on normal paper. Press film would also give a good print.

Figure 47 shows the same subject on commercial film giving a print that is too contrasty. This negative would give a good print on a soft paper. If the lighting had been such as to cause brilliant highlights and deep shadows this negative would not have been usable. In all three pictures the differences are entirely due to film stock, development having been carried to the same gamma and printing having been on normal paper.

TESTING NEW FILMS

When a new make of film is used it is well to make a few simple tests in comparison to your standard film in order to evaluate it properly.

(a) *Speed*

Fortunately laboratory tests are already available on film speeds. Your dealer will give you the latest Weston Film Rating Table without charge and here is a real comparison of film speeds made on a practical rather than theoretical basis.

(b) *Scale*

Films and plates are roughly classified as process, commercial, amateur, press and portrait. If there is any question in which group a film belongs, your dealer or the manufacturer will tell you.

Fig. 45
Average Subject on Portrait Film Developed to Gamma 1.

Fig. 46
Average Subject on Amateur Film Developed to Gamma 1.

Fig. 47
Average Subject on Commercial Film Developed to Gamma 1.

All Prints on Same Grade of Paper.

If you want a direct comparison, make two exposures of an average scene such as your own home in sunlight. Develop both negatives according to the manufacturer's instructions to the same gamma. With the photometer described later in the book, scale both negatives. This will clearly show how much difference exists.

(c) *Developing Time*
Time and gamma information can always be secured from the manufacturer of the film.

(d) *Grain*
If this is important make two identical exposures of an outdoor landscape including clouds, one your standard film, the other the new film. Develop both in the same developer. Make extreme enlargements and determine which shows most grain.

(e) *Gradation*
Make two exposures of a long scale subject, one on standard film and the other on the film to be tested. Develop both according to manufacturer's instructions. Go over the highest highlight and deepest shadow areas with a magnifying glass comparing tone separation and gradation.

COLOR AND EMPHASIS

The average photographer understands that panchromatic film is sensitive to light of all colors and, with a K-2 filter, registers color brightness as it appears to the eye. It might appear that the best procedure is to use panchromatic film exclusively because it gives the closest rendering to what is actually seen. However, in the finer points of photography, sensitivity to all colors is not always desirable. Like development and the selection of film stock the use of color sensitivity in the film depends entirely on the subject matter before the camera.

Some subjects confronting the photographer are a mixture of objects of many colors and negative stock is best selected to reproduce the brightness of these objects as they appear in nature. Other subjects have one predominant color tone and the photographer has the

Figure 48
Skin Texture with Orthochromatic Film

Figure 49
Skin Texture with Panchromatic Film

ability to bring in this dominant color as a light or dark tone, at will. This obvious means of tone control is overlooked by many photographers.

One of the means of achieving emphasis in a photographic print is the placement of light tones against dark tones. When a subject has one dominant color tone, the ability to bring in this color as light or dark can be used to emphasize this color in relation to the subject as a whole.

In portraiture the dominant color tone of flesh is red. In photographing the Grand Canyon, again the dominant color tone is red. In both cases all the reds can be emphasized by bringing them in dark or they can be subdued by bringing them in light. There is always the option of bringing them in at their natural values as well. The knowledge of the color-sensitive properties of films with the consequent ability to emphasize or subdue dominant color tones is a point of flexibility in the mechanical sequences of the photographic

process which can be made of great value in the production of effective photographs.

THE THEORY OF COLOR MIXTURE

The theory of color mixture involved is not difficult to understand. White light is a mixture of light of all colors. If three spot lights, one red, one green and one blue, are focused one over the other on a white wall, the addition of these three colors produces white. Red, green and blue are, therefore, primary colors and when they are added together in various combinations, all colors can be made from them.

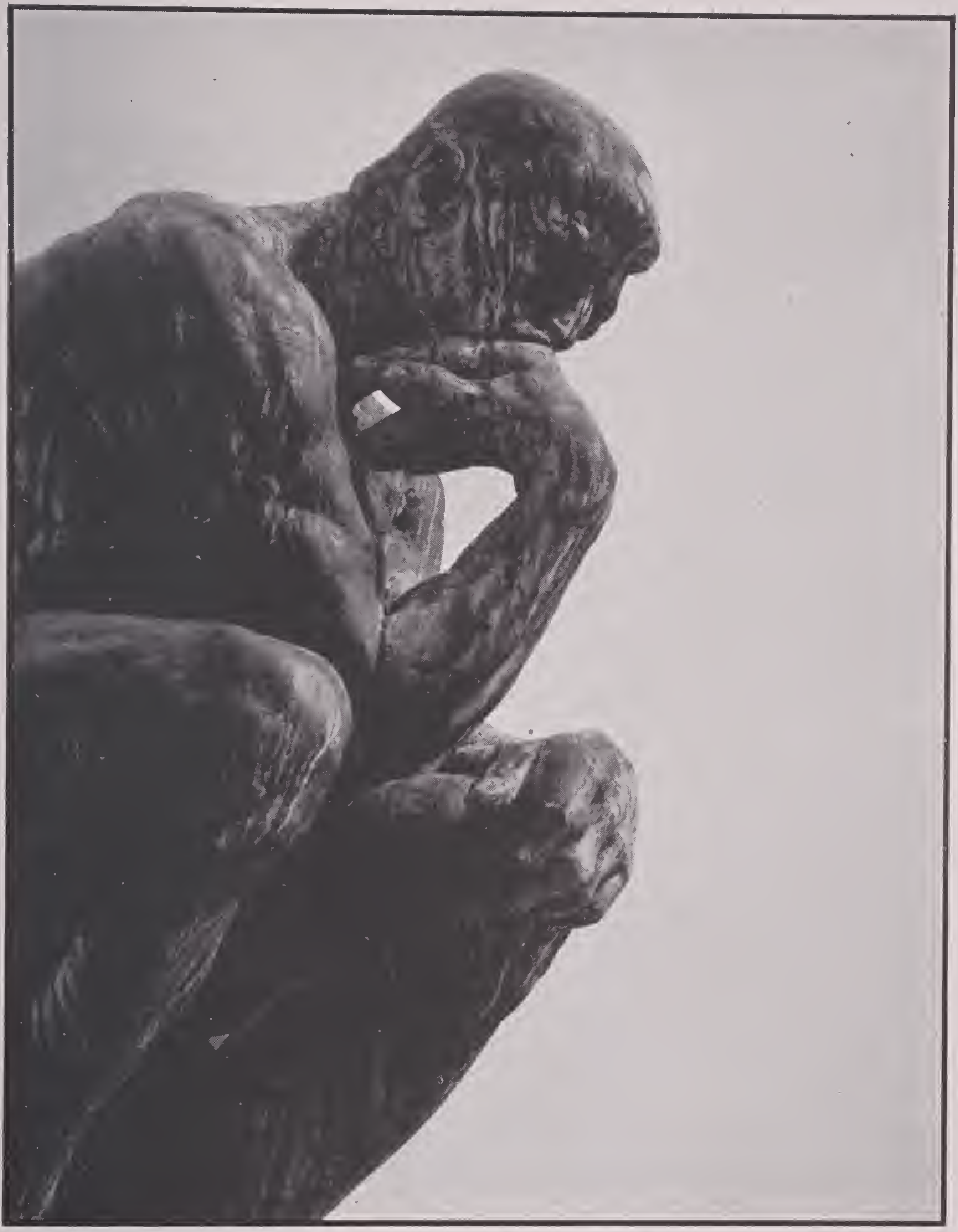
It should be kept in mind that there are two methods of mixing colors: by the addition of light rays and by the subtraction of light rays. The photographer is concerned with the additive system where the primary colors are red, green and blue. Painters are concerned with mixing pigments, which is the subtraction of light rays and the subtractive primaries are blue-green, yellow and magenta.

As white light is a mixture of red, green and blue light, all objects that appear white must reflect red, green and blue in equal proportions. Grey and black objects also reflect these colors in equal proportions and objects are white, grey or black, as the case may be, because of the amount of light they reflect, not because of the quality of the light.

Colored objects differ from white objects because they do not reflect all three primary colors in equal amounts. Some color is reflected and the balance is absorbed. A red object is red because it reflects more red than other colors. A blue object is blue because it reflects more blue than other colors. A green object is green because it reflects more green than other colors.

The one remaining color is yellow and this is the only difficult color relationship to remember. If we go back to the spot lights and add red and green light together, yellow is produced. Therefore, a yellow object is yellow because it reflects both red and green light together.

All other colors are the expected combinations. A blue-green results when blue and green are added together. Orange results when the red and green combination, which produces yellow, favors the red. All a photographer must remember is that the three primary



"Rodin's Thinker" *Paul Louis Hexter, A.R.P.S.*

Figure 50

colors with which he is working are red, green and blue, and that red and green in combination produce yellow.

Filters are small squares of dyed gelatin cemented between pieces of glass. They act exactly as one would expect. A red filter transmits red light. A green filter transmits green light and a blue filter transmits blue light. What does a yellow filter transmit? Yellow light is right but as yellow is the addition of red and green light, a yellow filter, therefore, transmits both red and green.*

THE COLOR SENSITIVITY OF FILM STOCK

The normal color sensitivity of a photographic emulsion is to blue and ultraviolet light only. To make films sensitive to other colors, dyes are added in the process of manufacturing the emulsions. If a film has no term describing its color sensitivity, it is known as regular film and has not been dyed. It is sensitive to blue and ultraviolet light. If a film is described as orthochromatic it has green sensitivity as well as blue, but no sensitivity to red. If a film is described as panchromatic, it is sensitive to blue, green and red.

The apparent belief that panchromatic film is best for all purposes is unfounded. Film stock must be selected with regard to the way it will record the color tones of the subject in the black and white scale. Only that film is best which records the tones in the way the photographer requires them.

When the statement is made that film stock is sensitive to light of a particular color, it means that tones of that color will be rendered as light tones on the print. The negative deposits silver for tones of this color which in turn makes them appear light in the print. If the film stock is not sensitive to tones of this color, no silver is deposited on the negative and these tones will be dark in the print. As a matter of fact all objects in nature reflect some light of all colors.

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* It is also interesting to know how the subtractive system of mixing colors works where the primaries are blue-green, yellow and magenta. Taking the familiar mixture of blue-green and yellow water colors; why does this produce green? If the blue-green and yellow pigment particles are visualized as two separate color filters placed one above the other on a white paper the explanation is quite simple. The blue-green filter on top transmits only blue and green when white light hits it, and allows only blue and green to go through to the yellow filter underneath. The yellow filter underneath transmits both red and green. As only blue and green hit the yellow filter the green alone is transmitted and this then hits the white paper and is reflected back to the observer, making the final color green.

To use these same colors in the additive system, white light would be passed through each filter separately and then added together as was done with the spotlights. The yellow filter would transmit red and green. The blue-green filter would transmit blue and green. When added together the blue, green and red would produce white, and there would still be green left over. Therefore, the resulting color would be light green.

"In Port" Paul Louis Hexter, A.R.P.S.

Figure 51

Red objects will register to some degree on green-sensitive orthochromatic film but they will definitely be dark tones. On panchromatic red-sensitive film they will be much lighter.

By the proper combination of film stock and filter, or in some cases with film stock alone, the photographer has a means at his disposal for rendering color tones as they appear in nature, or he can emphasize or subdue tones of any dominant color in any subject. The chart will clarify the selection of film and filters. To bring a dominant color in as a *light* tone, photograph with light of the dominant color. To bring in the dominant color as a dark tone, photograph *without* light of that color.

FILM AND FILTER SELECTION TABLE

Dominant Color	*To Bring In Dark Use*	*To Bring In Light Use*
Red	Orthochromatic film No filter	Panchromatic film Red filter
Green	Panchromatic film Red filter	(1) Orthochromatic film Yellow filter (2) Panchromatic film Green filter
Blue	(1) Orthochromatic film Yellow filter (2) Panchromatic film Yellow filter (3) Panchromatic film Red filter	(1) Regular film No filter (2) Orthochromatic film Blue filter (3) Panchromatic film Blue filter

To bring in colors as they appear without emphasis on any one color, use Panchromatic film and a K-2 yellow filter. While panchromatic emulsions are sensitive to red, green and blue, they are much more sensitive to blue than to either red or green. Using panchromatic film with a K-2 yellow filter which transmits both red and green, the amount of blue is cut down to where the film has approximately equal sensitivity to all three colors.

SOME PRACTICAL APPLICATIONS

In portraiture the dominant facial coloring is red and this may be emphasized by using orthochromatic film or subdued by using panchromatic film. Bringing the dominant reds in dark with ortho-

"Brittany" *Paul Louis Hexter, A.R.P.S.*

Figure 52

chromatic film emphasizes character-giving lines, blemishes, skin coloring and wrinkles. Bringing the dominant reds in light with panchromatic film minimizes all wrinkles, blemishes, skin coloration and lines. For vigorous portraiture orthochromatic film is desirable and it should always be used when maximum character delineation is desired (Frontispiece). For soft effects panchromatic film can be used. The differences are illustrated in Figures 48 and 49. Figure 48 also illustrates a common fault with orthochromatic portraiture—the lips are black. A light orange lipstick is an easy solution.

In landscape work the sky, predominantly blue, gives most con-

Figure 53

The Grand Canyon—Panchromatic Film K-2 Filter

cern. A blue sky can be brought in absolutely white with ordinary film. (Fig. 50.) To differentiate clouds from a blue background the blue must always be brought in dark. The choice of film to bring in blue as a dark tone to differentiate it from white is given in the Film and Filter Table, page 96. Figure 51 was taken with panchromatic film and a K-2 filter. When photographing a grey sky (Fig. 52) there is nothing to be gained by using a filter to subtract blue, for obviously there must be blue for the filter to work. There is no point in using any filter on a scene such as Figure 57.

Red is encountered as a dominant landscape color once in a great while, for example, at the Grand Canyon. The illustrations (Fig. 53 and Fig. 54) show the difference between registering the dominant reds without emphasis—panchromatic film and a K-2 filter, and emphasizing the reds using orthochromatic film.

In photographing landscapes, haze and fog in the distance can

Figure 54

The Grand Canyon—Orthochromatic Film

be emphasized by photographing with only blue light. (Fig. 55.) Photographing with red light will definitely subdue haze as the recent aerial photographs taken with infra-red demonstrate, showing mountain peaks three hundred miles away. Green light renders haze as it appears to the eye.

The few remaining die-hards who insist that photography cannot be used as an artistic medium have no conception of the possibilities for exaggeration that exist in this phase of color emphasis alone. If photography were the mechanical reproducing art which they claim, good photographs would be far more prevalent and easier to make than they are at the present time.

QUESTIONNAIRE ON COLOR

1. What are the three primary colors with which the photographer works?
2. Why is a yellow object yellow?

3. If two spot lights, one with a red filter and one with green filter, are focused over one another on a white wall, what color will be produced?
4. If the same two filters, red and green, are placed one over the other and white light passed through them, what color will be produced?
5. What is the difference between mixing colors in No. 3 and No. 4?
6. What colors are the following films sensitive to:
   (a) Panchromatic
   (b) Orthochromatic
   (c) Ordinary
7. If a film stock is sensitive to red, how will red tones appear in the print?
8. What film should you use in portraiture? State the reason and the disadvantages.
9. What film and filter would you use for clouds? Why?
10. Visualize a landscape with haze in the distance. What combination of film and filter would you use to:
    (a) Subdue the haze?
    (b) Emphasize the haze?
    (c) Register the haze as it is?

If you know your photographic technique you should be able to answer all these questions. If you miss any, a rereading of this chapter is called for. The correct answers are given at the end of this chapter.

EXPERIMENTS WITH FILM STOCK

1. Select a subject where material texture is the primary concern. Photograph a knitted dress, or a piece of upholstery, something where the texture while not too obvious is readily seen.
   Expose three commercial films, three amateur films and two portrait films. Develop the commercial and amateur series to gamma .8, gamma 1., and gamma 1.2. Develop the portrait films to gamma .8 and 1. Which film stock and development gives the best texture rendering?
2. On a long scale subject, such as a scene out of a window

Figure 55

including both a well-lighted interior and outdoors, make two exposures each on commercial, amateur and portrait film. Develop one set to a gamma of .8 and develop the other set in cut-back Pyro. Which film stock gives the best rendering? Does cut-back Pyro improve the rendering?

3. On a normal subject such as your own home on a bright sunshiny day, make one exposure each on press, commercial, amateur and portrait film. Develop to a gamma of 1. Make the best prints and compare. Can you make a good print from the portrait film? Measure the negative scales with the photometer described in Chapter Nine.

After making these experiments and those on developing in the previous chapter, which in your opinion has more to do with quality in the picture, the selection of film stock or the time of development?

ANSWERS TO QUESTIONNAIRE ON COLOR

1. Red, green and blue.
2. An object is yellow because when white light hits it, it reflects both red and green. Red and green added together make yellow.
3. Yellow.
4. Nothing—the red only lets red through and the green lets only green through. Whichever one is first passes only light of that color and the second filter will not pass it.
5. No. 3—additive method. No. 4—subtractive method.
6. (a) Red, green and blue.
   (b) Blue and green.
   (c) Blue.
7. Light.
8. Orthochromatic. Facial color is red. To emphasize facial coloring for best characterization the reds are brought in dark. Disadvantages are facial blemishes which are emphasized and lips go very dark.
9. Either panchromatic or orthochromatic film and a yellow filter.

   The yellow filter passes red and green but little blue. A white cloud is red, green and blue light. Blue sky is just blue light. The red and green go through the yellow filter and appear white on the print. The blue, held back by the yellow filter, goes dark on the print.
10. (a) Red filter and panchromatic film.
    (b) Blue filter and panchromatic film.
    Ordinary film no filter.
    (c) Orthochromatic film with or without green filter.
    Panchromatic film and green filter.

Chapter Seven

EXPOSURE

For a long time it has been known that the surfaces of certain metals such as zinc, potassium, selenium and others, in vacuo, exhibit the property of emitting electrons when illuminated. The strength of these electronic currents measured by a sensitive galvanometer gives an accurate measure of the intensity of illumination. This is the principal of the photoelectric cell.

In photographic use the light reflected from any scene is measured and, on cleverly designed scales, translated into terms of diaphragm openings and shutter speeds. It is the best method yet devised for accurately gauging exposures.

Exposure performs a dual function in the making of a negative for it registers the tones on a negative and determines the density at the same time. As long as the functions of each of the factors of development, selection of film stock, exposure and lighting are considered separately and apart from the others, even though they are obviously related, the making of negatives with predetermined characteristics is easily carried out. On page 58 are the functions assigned to each step in negative making. Always keep them separate and apart from each other.

The exposure time for any subject depends on the speed of the film-developer combination, the amount of light reflected from the subject, and the contrast of the subject.

FILM SPEEDS

There are four different systems of rating the speed values of films: H and D, Scheiner, DIN, and Weston. The first three are ratings based on laboratory exposures to step wedges, laboratory developers, and other refined sensitometric procedures. The Weston ratings are based on practical experience with the manufacturer's recommended developer. Weston ratings are published and kept up to date in the United States and are readily available. From a practical standpoint Weston ratings are the best, and only photoelectric cell exposure meters calibrated for Weston ratings should be purchased.

There are meters of other than Weston manufacture which are based on the Weston system of speed rating. This does not mean that the ratings published by the Weston Company should be used with such meters. Only the ratings published by the manufacturer of the meter are applicable.

EXPOSURE METERS

Since the system of exposure determination which follows is based upon the Weston system of speed rating, the author naturally recommends the use of the Weston meter, either Model 650 or the new and improved Model 715.

This does not imply that fine work can not be done with good meters of other manufacture. Instruction books supply full details on how to use each meter so there is no necessity to repeat such instructions here.

THE FUNCTIONS OF EXPOSURE

Films have periods of correct exposure, under-exposure and over-exposure. In the period of correct exposure each increase in exposure produces a proportionate increase in the density of the negative. In the period of under-exposure and over-exposure, increases in exposure do not produce proportionate increases in densities. To correctly record the tones of the subject, they must be recorded in the period of correct exposure.

The silver deposited as a negative tone is an aggregation of individual particles of silver. Each of these particles stops or reflects

some light. As negative tones become more dense it is more difficult to pass light through them.

In enlarging, the light source is always much weaker than in contact printing and negatives for enlarging cannot be too dense if tone separation is not to be degraded. It is quite possible to properly select film stock; develop it so that subject-negative tone ratios are properly controlled; expose it so that all tones are in the period of correct exposure, yet have a negative that is too dense for enlarging. The functions of exposure are to register the tones in the period of correct exposure and also to prevent the negative from becoming too dense.

Supposedly there is great latitude in exposure and a number of different times which will give a correctly exposed negative. There would be this latitude if the density of the negative had no effect on its printing quality.

For example, amateur films have a scale of 1-128. This means that they will record in a geometric progression light intensities as

1	2	4	8	16	32	64	128
(1)	(2)	(3)	(4)	(5)	(6)	(7)	

The figures in parentheses show the number of steps in the geometric progression. Many subjects confronting the photographer utilize no more than four steps in the progression, so that the period of correct exposure can be from steps 1 to 4, or 4 to 7, or any place in between.

When the scale of a subject is 1-128, and the film is capable of registering a scale of 1-128 the exposure must be absolutely accurate for there is only one exposure time which will register all the subject tones on the film. If, however, the scale of the subject is 1 to 8 a number of different exposure times can be used placing these tones in the steps 1-8, 2-16, 4-32, 8-64, 16-128, or any steps in between. All the ratios are still 1-8. The exposures also can be placed at 6-48, 10-80, etc. The only effect of these varying exposure times, as long as they are within the range of the film, is to increase or decrease the density of the negative. Tone contrasts are in no way altered. Thus the shorter the scale of the subject the more latitude there is in exposure for there are a greater number of steps into which it will fit. The longer the scale of the subject the less latitude there is

for, of course, there are fewer steps where it will fit. When subject scale and negative range are equal there is no latitude for only one exposure can be given to make them coincide.

In contact printing more or less negative density does not effect printing quality. This does not hold true in enlarging and a thin negative always enlarges better than a dense one. The purpose of exposure is to register all tones in the correct exposure portion of the negative, and when making negatives for enlarging, to register tones correctly without a negative of too great density.

ESTIMATING EXPOSURE

For years photographers have been told to expose for the shadows and let the highlights take care of themselves. Not all photographers subscribe to this and a well known teacher reverses it and recommends exposure based on the highlight area with the shadows fending for themselves. Still another worker recommends twice the reading of the exposure meter with one-half development time. Just as there are a number of confusing recommendations on developing methods and developers, so there are confusions in the procedure for estimating correct exposure. Intelligent use of a photoelectric cell exposure meter makes all these precepts entirely unnecessary.

When photoelectric cell exposure meters were first brought out the Weston speed ratings in use placed tones in the middle of the density scale. Many workers found this procedure gave negatives too dense for fine enlarging quality and they worked out various compensations for the meter readings. In August 1938 the Weston ratings on all films were changed to give negatives of less density, using maximum emulsion speed. New group ratings are now given for each film providing for thin, medium or dense negatives. In the Time-Gamma Tables (pages 67-69) the revised Weston ratings are included, but the maxim ratings are used to provide thin negatives which are ideal for enlarging.

As the Weston ratings take into consideration the different degrees of development required by various subjects no compensation in exposure need ever be made for subject matter as long as

1. Film stock is properly selected
2. Development is carried to the specified gamma on which the Weston film speed is based.

Weston speed ratings have been determined by development to specific gammas. All portrait films are developed to gamma .9, commercial and amateur films to gamma 1., press films to gamma 1.2, miniature films to gamma .8 and process films to a gamma of 3.

When a film is developed to a different gamma, then the Weston speed rating should be changed accordingly and for a change in gamma of .1 the speed rating should be changed by one division on the Weston scale.

Weston Speed ratings are based on a geometric progression of

1 2 4 8 16 32 64 128

Between each step in the progression are two subdivisions so that the derivation of the actual speed ratings is:

WESTON SPEED RATINGS

1
1.2
1.5
2
2.5
3
4
5
6
8
10
12
16
20
24
32
40
50
64
80
100
128

Eastman Verichrome is rated at Weston 32 assuming develop-

ment to gamma 1. If it is to be developed to a gamma different than 1., on which it was rated, then the Weston speed should be changed. If a higher gamma is used the Weston rating should be increased. If a lower gamma is used, the rating should be decreased. Fortunately there is an exact relationship here and a change in gamma of .1 in development should be accompanied by a change of one division in the Weston rating.

Thus if Verichrome is to be developed to gamma 1.1 the Weston rating increases one division from 32 to 40. If it is to be developed to gamma .8 (a change of .2) the Weston rating is decreased two divisions from 32 to 20. The change of .1 in gamma, increase or decrease, is always accompanied by a change of one division in the Weston rating, increase or decrease. For a change of .2 in gamma the Weston rating is changed two divisions. For a change of .3 in gamma the Weston rating is changed three divisions.

A press film with a Weston rating of 125 when developed to gamma 1.2, should be used at a speed rating of 80 when developed to a gamma of 1. (A change of two steps.) A commercial film with a Weston rating of 10 when developed to gamma 1.0 should be used with a speed rating of 16 when developed to a gamma of 1.2. (Two steps.) A portrait film with a Weston rating of 32 when developed to a gamma of .9 should be used with a rating of 40 when developed to a gamma of 1. (One step.)

The present Weston ratings are based on maximum film speeds and give fully exposed negatives of minimum density. Some workers prefer more density and where this is the case the lens should be opened by one stop or the shutter speed halved.*

When systems of film speed ratings other than Weston are used, and depend on similar development of all films, the following exposure table should be followed:

TABLE FOR EXPOSURE WITH FILM SPEED RATINGS OTHER THAN WESTON

Subject	*Exposure*	*Development*	*Film Stock*
Average Contrast	Normal	Gamma 1.	Average Scale
Low Contrast	½ Normal	Gamma 1.2	Short Scale
High Contrast	2 x Normal	Gamma .8	Long Scale

* This also increases shadow detail.

This is the procedure usually used in compensating for widely different subject scales when a Weston meter is not used. In using the method of changing the Weston rating according to development the same compensation is achieved, only with greater accuracy.

The ideal method of working is to change both film stock and development according to subject scale. Figures 43, 44 and 45 illustrate the differences achieved with film stock alone. Figures 33, 34 and 35 illustrate the differences achieved in development. Combining these together gives the greatest possible control in negative making. This, of course, is not always possible or practical.

When it is impossible to change film stock, development and exposure, then development and exposure alone must be keyed to the subject matter to allow for as much compensation as possible. The methods given in this book show an easy way in which to key exposure and development together without any guess work.

What then is the procedure when roll film is used and development cannot be varied? The only way out is to stay with subject matter which the film will record at one developing time. If the camera is loaded with film designed for average contrasts do not expect the impossible. Prints of subjects with low contrasts will be dull and those of high contrasts will be too contrasty. The camera, while a marvelous mechanical instrument, will always require thought behind its operation.

SUBJECT CONTRAST

In Chapter Five is a table for the classification of subject matter into groups of Low Contrast, Average Contrast and High Contrast. Sometimes the eye is not the judge of contrast it might be. Contrast depends on the ratio between the lights and shadows and the eye at times confuses brilliance and contrast. An extremely bright scene can be of low contrast. Therefore, when in doubt measure the contrast of a scene by reading both the highlight and shadow parts on the exposure meter. Use the following table:

Scene	*Ratio of Tone Contrast*
Low Contrast	1-16 or under
Average Contrast	1-16 to 1-64
High Contrast	Over 1-64

PRECAUTIONS

When the exposure meter is at an angle of 45° and no light reaches the photoelectric cell, the pointer should be at zero. If this is not the case the meter is out of adjustment. The reason for holding the meter at an angle of 45° when testing is to insure the floating of the pointer.

Some meters have a screw adjustment to correct pointers that are out of line. To make this correction place the meter on a book so that no light reaches the photoelectric cell. Hold the book at a 45° angle and turn the screw until the pointer is exactly at zero.

During dry cold weather the glass on the instrument may become electrified attracting the pointer and causing errors in the readings. Breathing on the glass will eliminate any electrostatic charge.

When using the meter, direct it downward to include as little of the sky as possible especially on cloudy, hazy, overcast days. No direct sunlight should ever enter the meter from any angle. The meter can be shaded if absolutely necessary.

While the photoelectric cell exposure meter is a marvelous instrument its readings must be tempered with a complete understanding of what these readings mean and when scenes that are not average are photographed, the readings of the meter must be thoroughly understood. Photoelectric cell exposure meters average the amount of light reflected by any scene. The exposure reading is calibrated on the assumption of an even distribution between light and dark tones. If there is not average distribution between lights and darks, the exposure readings should be compensated.

In estimating whether a scene is of low, average, or high contrast, remember that most scenes are of average or low contrast. Even in a portrait studio most scenes are not of high contrast, although this is not generally understood.

In any scene with a principal object always base the exposure on the light reflected by the principal object, rather than on the average scene as a whole. In a picture such as Figure 17 the exposure is measured with the meter held close to the bronze, not by pointing the meter at the entire picture area from the viewpoint of the camera. In portraiture (Frontispiece) the exposure is measured with the meter held close to the facial area. The rule is to base the exposure on the principal object whenever there is one.

EXPERIMENTS IN EXPOSURE

1. Make two negatives of a subject of average contrast such as a studio portrait. Make one negative with normal exposure and normal development. Make a second negative with double exposure and half development.

   Is there anything to the idea of doubling exposure and halving the development time?

2. Make five negatives of an average subject giving exposures of ¼ normal, ½ normal and 2x normal and 4x normal. Develop all five normally. Examine the negatives carefully. Measure the negative scales with the photometer. (Chapter Nine.) Print the pictures making the best possible prints.
   - (a) Was printing paper of different grades necessary?
   - (b) Did the contrast of the negatives change with exposure?
   - (c) Did the density of the negatives change with exposure?

3. On a scene of low contrast with press film, developed to a gamma of 1.2 make a regular exposure and an exposure of one-half this time. What happens?

4. On a scene of high contrast such as an indoor-outdoor combination make a regular exposure and an exposure of twice this time. What happens?

5. Write down in chart form the standard procedure for development, selection of film stock, and exposure for high, average, and low contrast subjects.

If you cannot do this and explain exactly why each step is taken, reread these chapters dealing with negative making.

Chapter Eight

LIGHT AND LIGHTING

Undoubtedly the greatest difficulty encountered with lighting in photography is caused by the fact that the photographic emulsion and eye differ greatly in the way they see color and shadow. While a fully panchromatic film is sensitive to all colors, it is most sensitive to invisible ultraviolet, to blue and to red, the colors to which the eye is least sensitive. The eye is most sensitive to green, which explains the failure of some pictures which appeared quite attractive at the time of taking.

In addition to seeing color differently the eye and the film see shadows differently. All photographers becoming interested in portraiture have a go at 45° Rembrandt lighting. To the eye, the shadow side of the face seems to reflect a reasonable amount of light. If the negative is made without the use of a reflector or balancing light, the shadow side prints, not dark, as it appeared to the eye, but absolutely black. The eye sees sufficient light in the shadows but the film does not.

While nothing takes the place of experience in gradually developing a "seeing" sense for photographic possibilities, one very valuable asset which saves many a wasted picture is a viewing glass. This is a monochromatic filter which when placed in front of the eye is a way of seeing lighting and coloring in photographic values. Satisfactory viewing glasses are: Wratten #90 Filter, Ilford Photographic Vision Filter, or Scheibe Viewing Filter.

No picture should ever be taken unless it is first viewed through

Figure 56
"Mask"

a viewing glass. Shadows with sufficient illumination to the eye but insufficient illumination for the film, are immediately caught, for under the viewing glass they go just as black as they would on a print.

The second use of the viewing glass is in connection with color filters. Instead of guessing whether a K-1, K-2, K-3 or G filter will give best results, the viewing glass and color filter used together to view the scene will give an excellent indication of what can be expected from different filters.

MEANING OF LIGHTING

Lighting in photography can be used in two ways. It can be used solely as a means of illumination without which the picture cannot be taken, or it can be used to create a pattern of light and shade across the subject. When a picture is to be of interest for the subject matter itself, revealing the essence of the subject through surface textures, light is used solely as a means of illumination, as in the

Frontispiece. When a less interesting subject is photographed and presented under a pattern of light, light here is used to create interest in the appearance of an otherwise uninteresting object, as in Figure 56. In one the interest is solely in the subject. In the other the interest is primarily in the pattern.

Figure 57 is a scene where the mood is re-created for the observer by a pattern of light. The subject itself, a truck and a few old buildings on a street are uninteresting of themselves but are made interesting by the particular light pattern. On the other hand the Frontispiece is a portrait in which light itself is used only to make the picture. The interest and significance is in Alexander Woollcott's face, not in any artificial pattern of light cast over his face to make him look like a Hollywood movie star.

It is not possible to have pattern lighting and reveal the essence of the subject at the same time. If the subject is important, the pattern cast by lighting detracts from this importance. Pattern lighting is used to make less interesting and commonplace subjects more interesting and more significant. This is demonstrated in the glamour portraits of Hollywood stars and the attention value of good advertising photographs.

Basically, artificial lighting indoors and natural lighting outdoors are alike in that they are used either for pattern or illumination. However, artificial lighting indoors is entirely under control of the photographer and outdoor lighting never is.

OUTDOOR LIGHTING

Lighting outdoors is primarily pattern lighting. There are very few subjects outdoors which are photographed for themselves rather than their appearance under certain conditions of light. Figure 58 is an exception to this. It is the realization of this that makes the difference between a photographic record and a picture.

Monet painted 20 different canvases of the Cathedral at Rouen at 20 different hours to show the changes light made in its appearance. A photographer who has mastered his technique and is trained to observe the effects of light might make a similar series of studies. The height of the sun, the haze in the sky, the cloudiness, the light before a storm, cause tremendous changes in the appearance of objects in any scene.

"Rifting" Paul Louis Hexter, A.R.P.S.

Figure 57

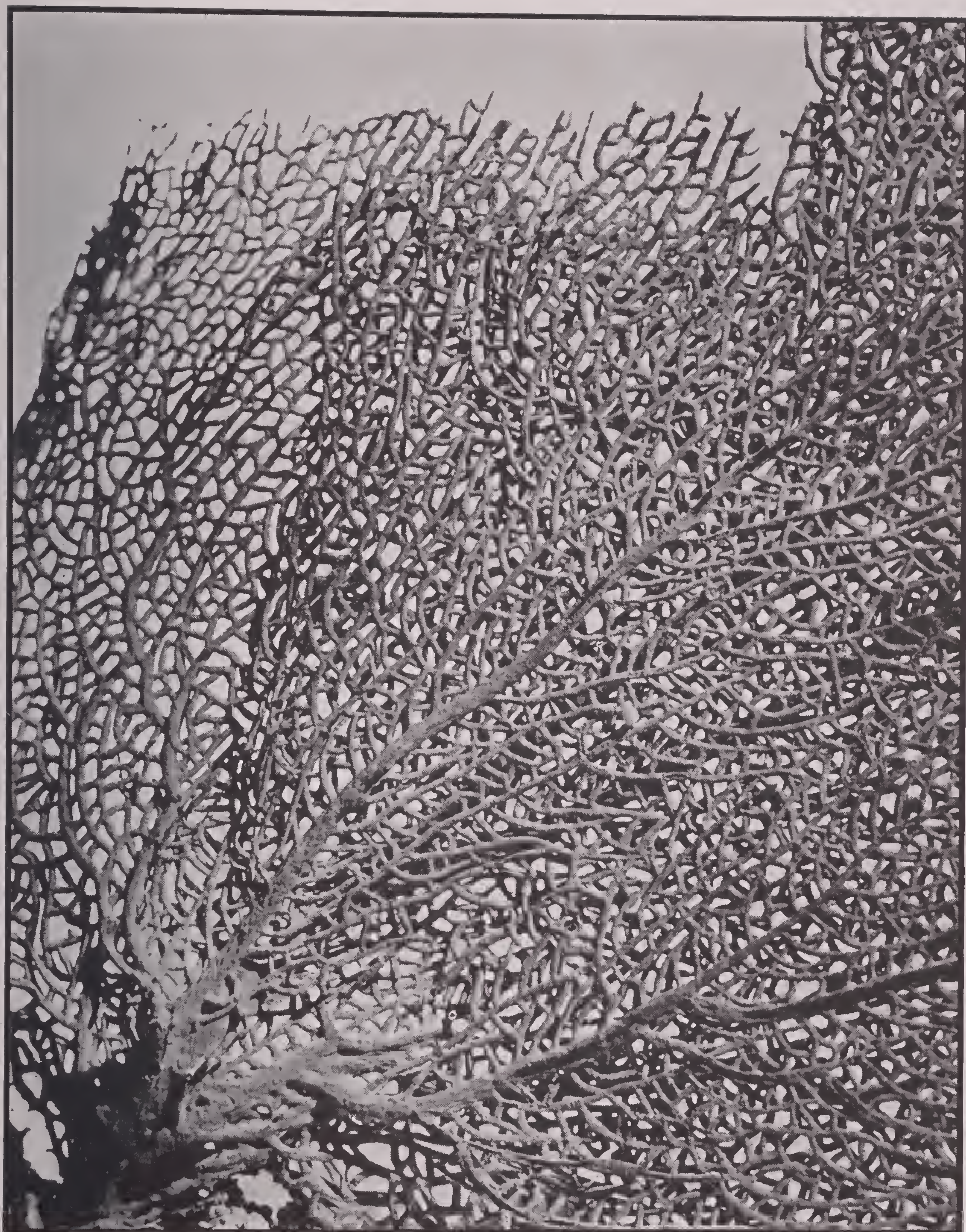
"Sign of the Times" *Paul Louis Hexter, A.R.P.S.*

Figure 58

The photographer of landscapes and other outdoor scenes must see his subject under many different conditions of light before he can determine which condition will express the mood, feeling, and meaning in a photograph. A constant study must be made of the effect of light. In fine work the scene is a photograph under certain conditions of light, not a record of the scene taken because there is sufficient light with which to make an exposure.

Landscape photography is not a question of a walk in the country on a Sunday afternoon to snap a few wayside shots, although many pictures show they have been taken this way. It is a matter of infinite patience, detailed study, and perhaps a wait of months for the proper conditions of light until a worthwhile expression is obtained.

The hours from ten until two, when the sun is high in the heavens, are uncomplimentary to nearly all outdoor subjects. The almost vertically down direction of light at that time of day plays as much havoc with the subject as an unmodified vertical light does in a studio. Inky black shadows make their unwanted appearance



"Coral — Paul Louis Hexter, A.R.P.S.

Figure 59

wherever this light casts them and these shadows are beyond redemption.

INDOOR LIGHTING

In studio work the photographer is not dependent on nature for the appearance of his subject under certain conditions of light. These conditions are subject to his control at all times. The subtle light required in photographing for the essence of the subject, or infinite varieties of pattern lightings, can be produced at will.

For most photographers a system of lighting must be used where the effect of light is clearly seen. The system also must be simple enough so that the photographer can understand and see what is done with each light and with the lighting as a whole. Elaborate systems cannot be considered because the expense and space required.

There is one system of lighting which conforms to these conditions, known as the Mortensen System. It is simple, inexpensive, requires no special installations and is adequate under conditions of both pattern lighting and straight illumination. It can be standardized to work anywhere under all conditions. Later, more elaborate forms of lighting can be attempted but it is doubtful whether they will be needed or are worthwhile.

If lighting indoors is once mastered so that interesting pictures with straight illumination can be made (Fig. 59, Fig. 60, and Fig. 61) pattern pictures will become a minor part of the lighting technique rather than the major technique itself. The appreciation of possibilities in outdoor lighting is made far easier after indoor lighting is mastered.

For lighting equipment, two 8½ inch aluminum reflectors on seven-foot adjustable standards are required. The reflectors should have an adjustable tilt. Clear 500-watt projection bulbs should be used in preference to photofloods, as projection bulbs maintain an even quality of light over their useful life.*

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* My own equipment used in making all the illustrations for this book consists of two 8½ inch Sun Ray aluminum reflectors with standard sockets manufactured by the Sun Ray Photo Company, 309 Lafayette St., New York, N. Y. Clear 500-watt projection bulbs are used in them.

"Frustration at Forty" *Paul Louis Hexter, A.R.P.S.*

Figure 60

Do not use 12-inch reflectors with photofloods and expect the same results. Use the lights specified. The cost is one-tenth that of a good camera and is well worth the expenditure.

The first step is to find out whether both lights give the same amount of illumination. Set first one and then the other six feet back from a white wall and measure the illumination on the wall with your exposure meter. Reflectors and bulbs of the same manufacture vary. Mark which light gives the most illumination so this will always be used as the front light. Do not change the lights around. Photofloods vary so much over their useful life that lighting cannot be standardized with them.

In this system of lighting a white wall background is always used. This white wall is illuminated by a standard amount of light and the amount of light on the subject is always compared to the background. This is somewhat of a Rube Goldberg photometer. The front light is moved back and forth from the subject until the illumination on both subject and background are the same.

In the standardized set-up the value of the illumination on the background is measured in foot-candles on an exposure meter. Whether the photograph is taken in your own studio or some strange place is of little moment for as long as there is a white wall background, the same amount of background light can be used anywhere. As the subject is always matched to this constant background illumination, the exposure will be constant.

When photographing for the ultimate in surface values and textures, exposure is so critical that there can be no guesswork. Having standardized the amount of light for each part of the set-up, and having a visual means of comparison, the exact exposure once determined, can always be repeated.

In setting up, the subject is placed about five feet from the background and the background light placed four to six feet from a white wall, four feet to one side of the subject. It should be at the same height as the subject's head. There must be no spill from this light onto the subject. From the position of the subject the white wall background should give a reading of 16 foot-candles with a photoelectric cell exposure meter to duplicate the actual conditions under which my portraits are made. The actual distance from the

"Rose" *Paul Louis Hexter, A.R.P.S.*

Figure 61

wall necessary to obtain a reading of 16 foot-candles will vary with the whiteness of the wall and the efficiency of the reflector. This knowledge of a standard value of the background illumination permits the setting up of similarly illuminated backgrounds in places other than the studio.

The front light is placed on the level of the subject's head about five to six feet in front of the subject which will be ten to twelve feet from the background. Adjust the distance of the front light until the light area of the subject and the white wall background match, (Fig. 62) viewing the subject through the viewing glass for comparison.

This method of arriving at a standard light area illumination for every subject compensates for differences of skin tone in various subjects. Once the light area and the background are matched, the photographer can control the rendering of the light areas, making them lighter, the same, or darker than the background, just by moving the front light closer to or farther from the subject.

The camera is then brought up, placed at the proper distance from the subject for the picture and the exposure is made. The camera should never be more than nine inches lateral distance from the front unit. The front unit should be placed on the opposite side of the camera from the background light. The front light can be either in front or behind the camera, higher or lower, but the lateral distance of nine inches from the lens must not be exceeded. If the camera is placed behind the front light the outline of the subject is accentuated. (Fig. 63.)

When light is used solely as a means of illumination the front light should be kept as close to the lens as possible. As the front light moves either to the right or left, up or down, pattern is created by shadow. The transition into pattern lighting is, of course, gradual. The more pattern, due to light, the less the significance of the subject itself will be revealed.

Raising the front light six inches, or moving it slightly to one side will change the highlight arrangement of the picture. Either side of the face, the forehead, or the chin can be made the most prominent light area. Highlights along the nose can straighten a crooked nose or crook a straight nose. These problems in capturing

Standard Lighting Diagram

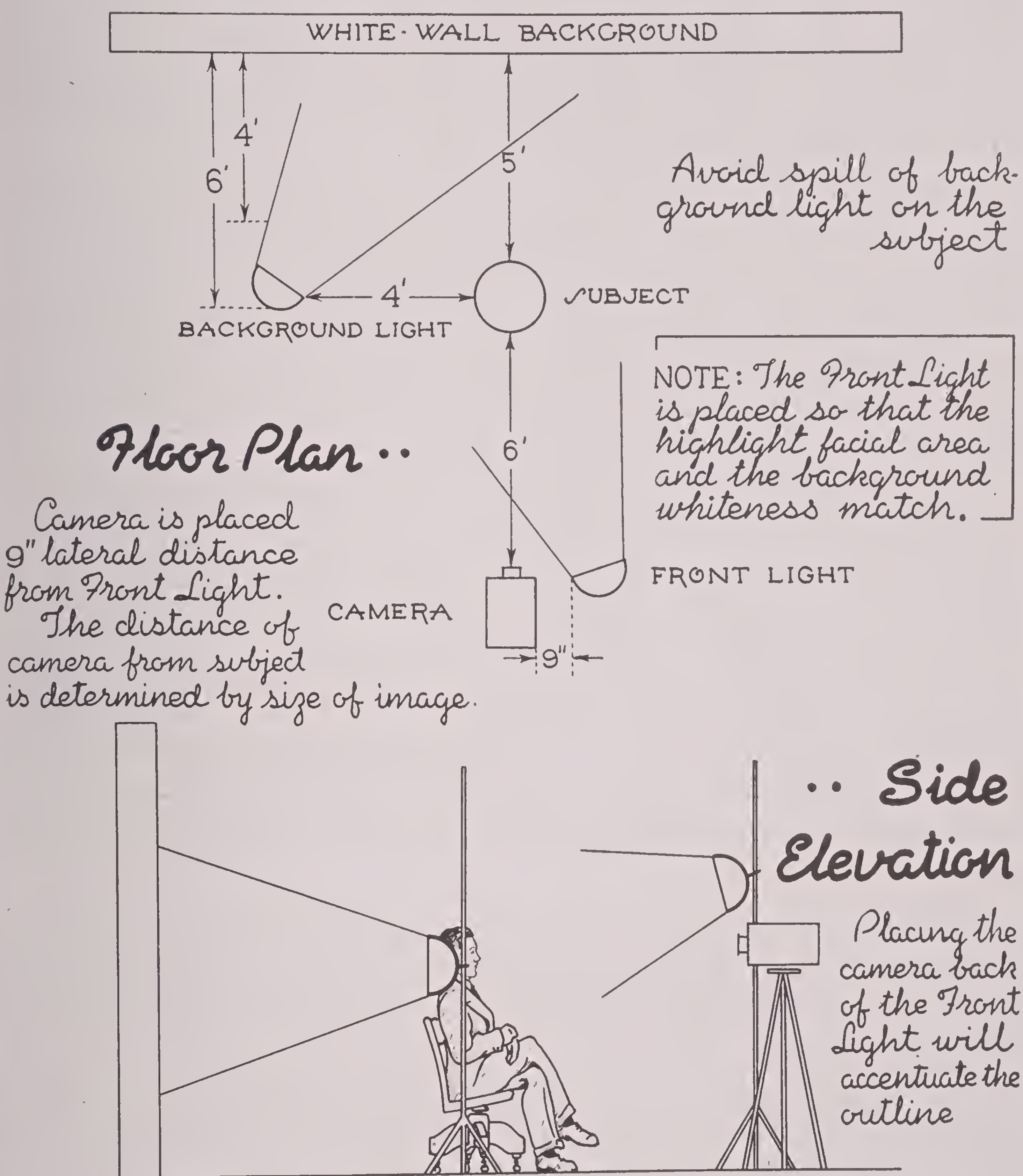

Figure 62

likeness confront the photographer in portrait work and this lighting set-up will permit of their easy solution.

The use of a single front light takes advantage of the dilution of light over an area as the area recedes from the source of light. Ears and the outline of the face will be lower in tone than the forehead, nose and areas closer to the light source, giving the effect of depth in the picture. If two front light units are used the effect of the dilution of light by distance is nullified.

When the background illumination is 16 foot-candles and the subject and background are matched evenly, the front light will be four or five feet from the subject depending on skin coloration and the subject's face will be illuminated by about 8 foot-candles of light according to your exposure meter. In reading the illumination of the subject's face take care not to include the white background and not to cast a shadow on the subject's face.

Lenses differ, shutters differ, and exposure meters differ. The standard exposure in my studio is $\frac{1}{2}$ second at f:9 on Verichrome for 8 foot-candles. This exact time must be determined by trial and error. It will vary for every one, depending on equipment. Make test exposures until you find the exact time. The negative should look like Figure 32. This negative was made on Verichrome developed to a gamma of 1. The Weston film speed of 16 to Mazda light, gives the time of $\frac{1}{2}$ second at f:9 for 8 foot-candles. Slight variations in the placing of the light can always be checked with the meter.

If, instead of the front light being five feet from the subject, it is used at two feet, knowing the standard exposure for 8 foot-candles is correct, a new reading can be taken and the exact exposure found for the increased illumination.

The photographer can standardize his exposure time with the particular background, lights and film that he is using. Once this time is determined there is no reason for not making perfect negatives with every exposure. The best negative can then be selected from all the exposures of any sitting without any reason for compromise between better negatives and poorer poses.

With the usual photographic procedure, lighting the subject in this manner will produce a very flat picture. This lighting, used with

"L. Moholy-Nagy" *Paul Louis Hexter, A.R.P.S.*

Figure 63

In this illustration accentuation of the outline is also increased through Solarization.

orthochromatic film, either amateur or press, developed to a gamma of 1.1 will give subtle tone distinctions that exaggerate modeling and contour. (Fig. 64.) There always will be catch lights in the eyes, a highlight on the lower lip and various other highlights on the forehead, nose and chin, which are impossible to get in any other way, yet are extremely natural.

When a picture is to be of interest for the subject itself, and not the appearance of the subject under a pattern of light, this method of lighting must be used. It is a natural light, not a crisscross pattern concocted by the photographer in an attempt to emulate the publicity photographs of the movie stars in Hollywood.

DRAMATIC LIGHTING

At times when pattern lighting is called for, another lighting set-up is useful. Light coming from an angle of 45° to the side, and 45° from above the subject is known as Rembrandt Lighting. The background light is placed in the standard position but the front light is placed about two feet from the subject at the proper 45° angles. A reflector made from a piece of white cardboard must be used to illuminate the shadow side of the subject. This reflector is placed as close to the subject as possible without interfering with the picture. As the front light is very close to the subject the illumination from the subject will measure about 40-50 foot-candles. The correct exposure for 50 foot-candles is easily computed on the exposure meter. The background will come in as a dark tone.

A modification of Rembrandt Lighting can be used in a studio with white walls. If the front light is placed three feet from the subject, at the 45° angle, sufficient light will be reflected from the side walls so a reflector need not be used. The illumination on the face will be 20-30 foot-candles. The background will come in as a medium gray tone which is most effective with some subjects.*

Artificial lighting should be regarded solely as the means of illumination without which a picture cannot be taken. It is not the primary function of lighting to create a pattern across the picture, for the pattern then becomes of primary interest and the subject

* Only the briefest possible discussion of lighting technique is given here since there is no point in repeating that which is already competently and thoroughly covered elsewhere. For full details the author strongly recommends Pictorial Lighting, by William Mortensen, price $2.00.

"Ann" *Paul Louis Hexter, A.R.P.S.*

Figure 64

itself becomes secondary. Making a portrait under a pattern of light, the like of which the subject has never been under before, and probably never will be again, is an entirely artificial situation that does not make for likeness, modeling or tone separation.

MASTERING LIGHTING

This system of lighting always gives medium to low contrast. Amateur or press film that will develop to a gamma of 1.1 should be used. I much prefer orthochromatic to panchromatic film because of the emphasis on the dominant skin coloring. This may be too brutal for middle-aged women but it is honest and sincere. Verichrome film packs are recommended from personal experience. Doubtless other films are just as good but if a photographer gets one film that does the work there is no point in trying to find a second one.

After doing sufficient experimenting to be sure of the illumination values and standard exposure times, make the following experiments getting perfect negatives and making prints which retain full gradation.

1. Using the same model and same pose for all pictures: arrange the background light in the standard position and place the front light so that the white wall background and highlight area of the subject are the same intensity. Bring the camera up into position, use the viewing glass and without moving the camera but changing the front light make exposures so that:
   (a) The forehead and cheeks are equally lighted.
   (b) The forehead is brightest and one cheek is brighter than the other.
   (c) The forehead is still brightest but the opposite cheek is brighter.
   (d) One cheek is brightest and the forehead and other cheek are less bright.
   (e) The opposite cheek is brightest.

If everything is right, in printing, the white wall background will print as a light gray and the light areas will be accentuated as suggested. This may take several tries. Remember not to move the front

Figure 65

Straight print from a full bodied negative—see page 55.

Figure 82 is a distorted and shaded print from the same negative.

light more than 9 inches sideways from the lens or a bad nose shadow will come in.

2. Starting from the standard lighting, with the same model and same pose make the following exposures:
   (a) Front light and camera together.
   (b) Front light two feet in front of the camera.
   (c) Front light two feet behind the camera.
   (d) Front light four feet behind the camera.

   Work on these positions until you can make perfect negatives from any placement of the front light.

3. Make an outline profile portrait with the camera four feet behind the front light.

4. Make a portrait with 45° Rembrandt Lighting and a reflector.

5. Make a portrait with 45° Rembrandt Lighting and no reflectors, providing the studio has white walls.

Work out these experimental lightings until the placement of the light and the exact exposure time becomes second nature and your entire thought can be concentrated on the characterization of the subject without conscious attention to the technical part.

After mastering indoor lighting then make the following experiment outdoors. You will grasp the difference in appearance much more readily for you will have begun to train yourself in photographic "seeing."

6. Photograph your own house or some nearby attractive scene at the following times:
   (a) 8:00 A.M. — sunshine
   (b) Noon — sunshine
   (c) 6:00 P.M. — sunshine
   (d) Just before a storm
   (e) Late afternoon with the sun breaking through the clouds. Make straight prints and compare them.

Chapter Nine

EQUIPMENT FOR ENLARGING

After processing a negative specifically for enlarging, it is essential that the equipment for enlarging project all the delicate tone separations so they register on the printing paper. While all enlargers project enlarged images, it does not follow that all such images retain the full tone separation of the original negative.

Negative tones result from the deposition of silver and it is often assumed that the effective tone contrast in a negative is entirely dependent on the amount of silver deposited and on no other factors. When a negative is printed by projection the tone contrast and separation between tones depends on:

1. The amount of silver deposited.
2. The kind of illumination in the enlarger.
3. The strength of the illumination.

DIFFUSED OR CONDENSED ILLUMINATION

When the source of light in an enlarger is diffused by placing a ground glass between the source of light and the negative, the light rays are so scattered that they fall on the negative from every point on the ground glass and from all possible angles. (Fig. 66.)

When condensing lenses are placed between the light source and the negative, the condensing lenses collect and straighten the light rays so they all fall perpendicularly on the negative, all from the same angle. (Fig. 67.)

There is a marked difference in the projected image of any nega-

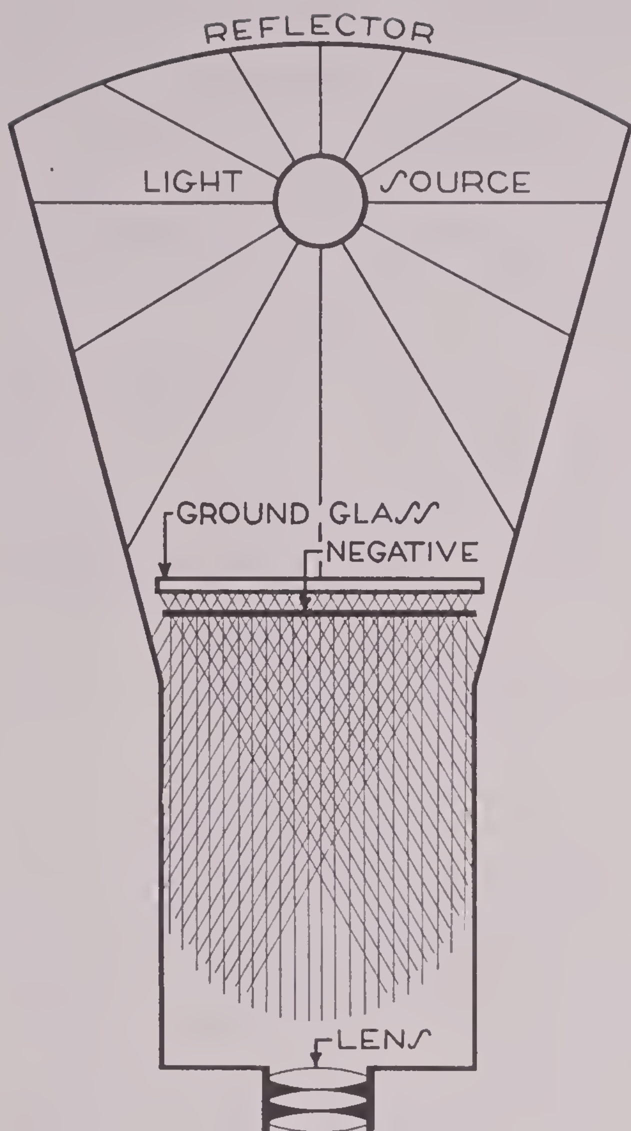

Figure 66

Diagram of Diffusion Enlarger.

tive when illuminated by diffused light rays and parallel light rays. This is easily understood referring to Figure 68. If a scratch on the upper side of a negative is illuminated by parallel rays of light, the scratch casts a definite, sharply defined shadow. If the same scratch is illuminated with scattered light rays, the shadow will not be as strong or well-defined because the shadow will be illuminated by light rays coming from points off the line of the scratch. Such a scratch almost disappears when the negative is projected with diffused illumination.

What is true about the scratch is true about delicate tone separations. The silver deposit on a negative is an agglomeration of many infinitely small grains of silver which appear to the eye as a solid tone but show granular structure when viewed under a microscope. Each particle of silver casts its own little shadow just like the scratch on the negative. Diffused illumination weakens these shadows and the tone separation and definition of a negative projected with diffused illumination is bound to be less than the original negative.

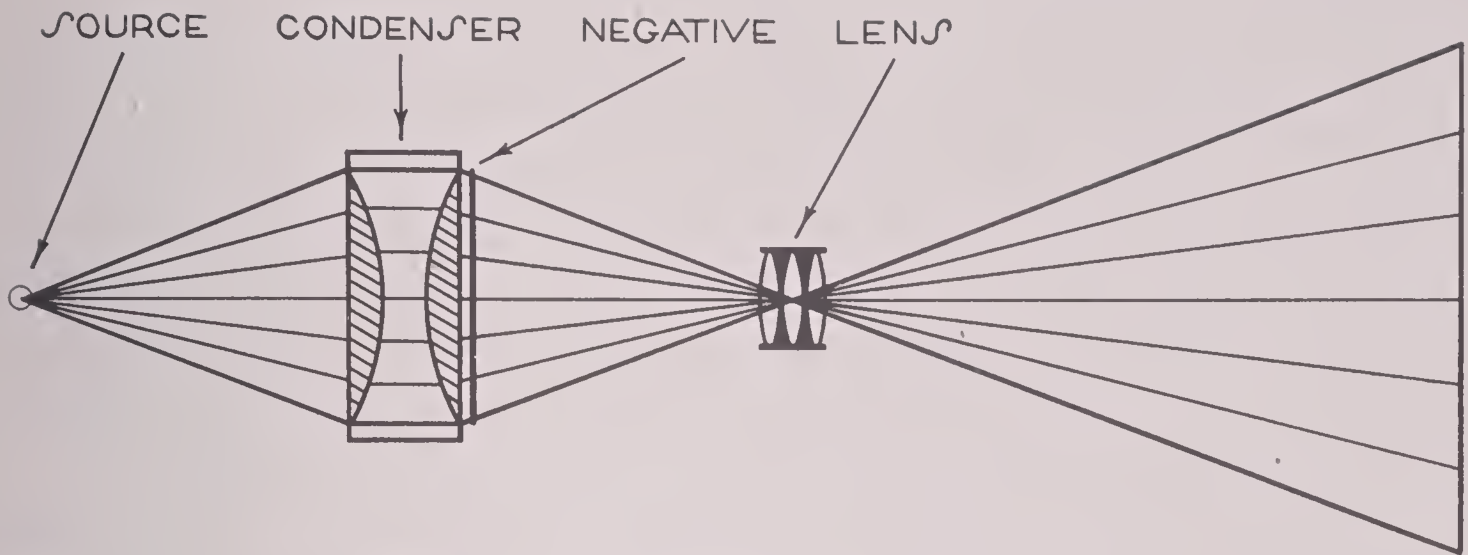

Figure 67. Diagram of Condenser Enlarger.

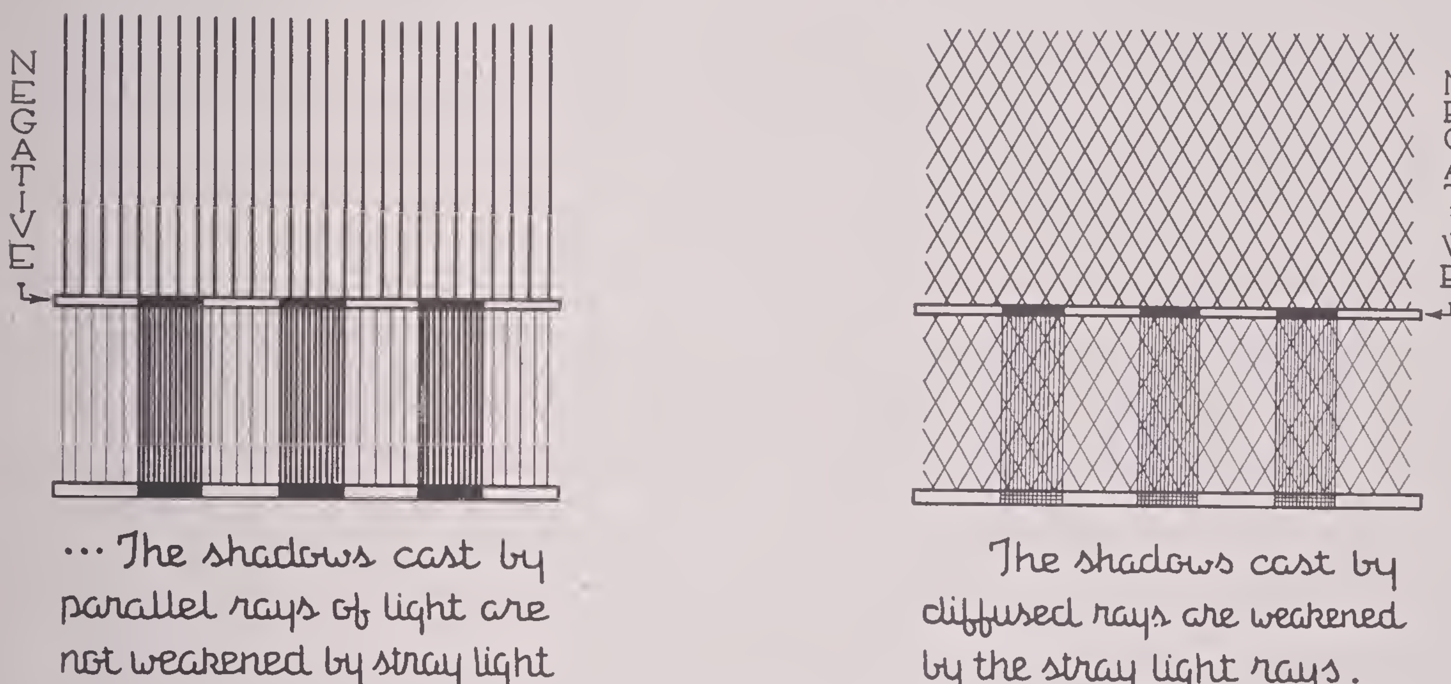

Figure 68. Diagram Showing Difference in Shadows According to Illumination.

The usual reasons for the use of a diffused light source: minimization of grain, scratch marks and blemishes are not as important as keeping the original tone separation of the negative. Enlargements can be made which have the sharpness and quality of contact prints, but not when diffused illumination is used.

The efficiency of the light source must also be considered. As the scattered illumination from a diffused light source falls on the negative from all possible angles, only a small portion of this light is collected by the enlarger lens. Due to the angle from which most diffused light falls on the negative, it is scattered against the bellows of the enlarger and lost. On the other hand parallel light rays which have been passed through condensers fall perpendicularly on the negative and all these rays are collected by the lens of the enlarger. The condenser type of illumination will give more than 15 times the amount of light compared to the same light source when diffused.

The amount of light used in enlarging definitely affects the quality of the enlargement. Most of us at one time or another have prepared a smoked glass with which to watch an eclipse of the sun. Such a glass is opaque to light of ordinary intensities but is penetrated by the sun's rays. Similarly the silver deposit on a negative is opaque to light of some intensities but transmits light of greater intensities. The tone separation in the denser portions of a negative is always enhanced by a more intense source of illumination.

With these facts considered, if fine quality and delicate tone separation is to be retained in the enlarged print, an enlarger with condenser illumination must always be used. Diffused illumination is not efficient, not sufficiently intense, and does not give separation to subtle tone gradations.

THE ENLARGER

It is unfortunate that most domestic enlargers for film sizes above 2¼ x 3¼, with the exception of the Simmons Omega D 4 x 5 and a few others, are equipped with diffused light sources, so that the proper type of condenser enlarger must either be imported or constructed. The Thornton Picard enlargers made in England can sometimes be picked up second hand. There may be some difficulty in importing a new one, although it is worth trying. There are many descriptions of condenser type enlargers which are not difficult to construct and are inexpensive. If the facilities for construction are not available a friendly carpenter, given the diagrams and materials, will build one reasonably.

Whether the enlarger is vertical or horizontal makes little difference, and is primarily a question of working space. Vertical enlargers are compact and require little room. However, an additional lens may be required to give extreme degrees of enlargement. With horizontal enlargers the degree of enlargement is limited only by the distance the enlarger can be placed from the enlarging easel.

The diameter of the condensing lenses should be slightly larger than the diagonal of the largest negative size which will be used. For 3¼ x 4¼ negatives, 6½ inch condensing lenses are quite satisfactory. There is nothing to be gained in using condensers which are larger than the required size.

By far the most satisfactory illuminant is a 400-watt T-20 photo blue projection lamp. This bulb gives constant illumination over its working life of 500 hours and the use of blue light gives sharper prints. A photoflood enlarger bulb is not satisfactory because of the wide variation in light quality over the short period of its two-hour life. A T-20, 400-watt photo blue bulb should be used as the light source, if at all possible.

In addition to having better tone separation, negatives projected with a point source of light, such as a clear projection bulb and condensers, show an increase in contrast over the original negative. This is known as the Callier effect. The granular structure of the silver deposit of a negative has the property of scattering light rays. When parallel rays pass through a clear portion of the negative there is no scattering of light and this tone on the paper receives its full quota of light. In a dense portion of the negative some scattering of light takes place and, therefore, this tone does not quite receive its full quota of light. As the dense tone on a negative is the light one on a print, the light tones of the print are slightly lighter, giving the effect of greater contrast.

The Callier effect of increased contrast is not noticed when a diffused light source is used, as the light is scattered before it falls on the negative and the scattering is the same in both clear and dense portions of the negative.

It is well to have both a clear lamp and an inside frosted lamp available, to take advantage of the Callier effect. An inside frosted lamp will not diffuse the light to the extent that it will degrade tone separation and, with it, the position of the light source in relation to the condensers does not have to be changed for every change in the degree of enlargement. The clear lamp is used when the optimum in contrast and tone separation is required.

CONTRAST CONTROL IN ENLARGING BY VARYING THE LIGHT SOURCE

Maximum Contrast	Clear T-20 Bulb condensers.
Good Contrast	Inside Frosted T-20 Bulb condensers.
Less Contrast	Clear T-20 Bulb, Ground Glass and Condensers.
Minimum Contrast	Inside Frosted T-20 Bulb, Ground Glass and Condensers.

Ground glass diffusion with a frosted bulb is almost the same as a diffusion enlarger.

The light source makes much more difference in the contrast of a negative than is usually thought to be the case. The same negative with an effective density scale of 1-8 from a completely diffused light source, and photo flood bulb, gave effective density scales of 1-10 with light source of a photo flood bulb and condensers; 1-16 with an inside frosted T-20 photo blue bulb and condensers; and 1-20 with a clear point source T-20 bulb and condensers.

The lens for enlarging can be any good anastigmat lens with covering power corresponding to the largest negative size. With vertical enlargers it is well to have a shorter focal length lens for extreme enlargements. The covering power of such short focal length lenses should be known, as the enlargement of negative areas greater than the lens will cover results in poor definition and falling-off of light around the edges of the print. Many lenses have the negative areas they cover marked on them. If they do not the maker's catalog will always give this information.

When selecting an enlarger choose one that has a negative carrier with an adjustable tilt. While this is not essential, it is quite useful in correcting the vertical lines of architectural subjects and making other distortions that sometimes increase the effectiveness of pictures. The Thornton Picard horizontal enlargers have a negative carrier that can be rotated as well as tilted and this adjustment saves straightening the negative after it has been put in the holder.

Proper enlarging equipment can be assembled for less than the cost of many popular cameras and to obtain quality in enlarging it is necessary to have the proper equipment. All enlargers will enlarge but enlargers with condensing lenses are far superior to diffused light source enlargers for fine photographic quality.

SUGGESTIONS ON CONSTRUCTING AN ENLARGER

There are numerous drawings and suggestions for building enlargers in current photographic books and magazines and these various designs are always modified to suit the individual. As there are certain essential relationships that must be worked out before constructing an enlarger the following points must be carefully considered:

(a) *Diameter and Focal Length of Condenser*

The diameter of the condensing lens should be slightly greater than the diagonal of the largest film size that will be used. Condensing lenses are supplied in pairs, mounted or unmounted in the following sizes and focal lengths:

Diameter	*Focal Length in Inches*
4	5½
4½	5½
4½	6½
5	6½
5½	8
6	10
6½	10
8	12
9	14

(b) *Focal Length of Enlarging Lens*

The focal length of the enlarging lens should be the same as the focal length of the condensers. Less than this decreases the amount of light that will get through. Greater focal lengths up to 25% of that of the condensers are usable. The reasons are entirely optical and a complete discussion will be found on pages 400 and 401 of "Photography, Principles and Practice" by C. B. Neblette. When diffused illumination is used any focal length lens can be used providing it will cover the negative size.

(c) *Distance of Light Source from Condensers*

To determine the nearest and farthest points that the lens will move from the negative, and to determine the nearest and farthest points that the light source will move from the condensers requires a little calculation.

Fig. 69 shows the conjugate foci of both the condensers and enlarging lens in a condenser enlarging system. For practical purposes ED and DF are the conjugate foci of the enlarging lens and AB and CD are the conjugate foci of the condensing lenses.

Consider the distance of the enlarging lens from negative first. This is the minor conjugate.

(1) Minor conjugate $= F + \frac{F}{R}$

Where F is focal length of the lens and R is that ratio of enlargement.

The minimum and maximum amounts of enlargement must be decided on. If the minimum is 2 x and maximum is 10 x, with a 7 inch lens, the distance would vary between

$$7 + \frac{7}{2} = 10\tfrac{1}{2} \text{ inches}$$

and

$$7 + \frac{7}{10} = 7\text{-}7/10 \text{ inches}$$

Now consider the distance of the light source from the condensers. The minor conjugates ED which have been worked out for the enlarging lens become the major conjugates CD in the condensing lens system.

(2) Major conjugate $= F + (F \times R)$

Where F is focal length of the condensers and R is the ratio of enlargement.

As the focal length of the condensers is known, and the distances for the major conjugate in maximum and minimum positions has been found, the above equation (2) is solved for the value of R.

We will assume for this example that the focal length of the condensing system is 6″.

Therefore $10\tfrac{1}{2} = 6 + (6 \times R)$

$6R = 10\tfrac{1}{2} - 6$

$R = .75$

and

$7\text{-}7/10 = 6 + (6 \times R)$

$6R = 7\text{-}7/10 - 6$

$R = .28$

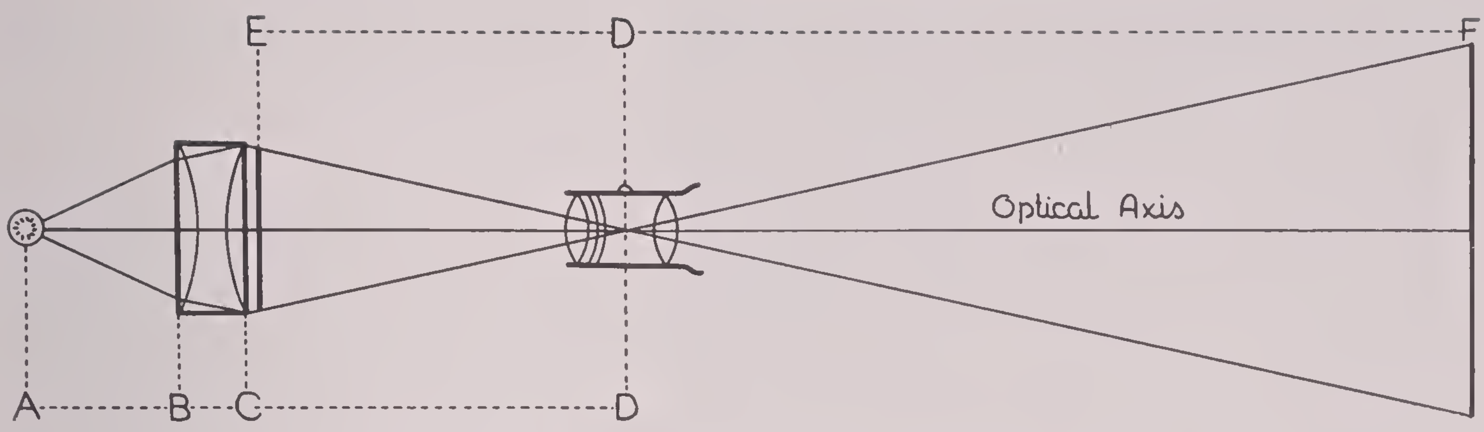

Figure 69. Conjugate Foci in Condenser Enlarger.

Having both values of R in the major conjugate, to get the distances through which the light source will move, solve for the minor conjugate in the enlarging system using equation (1).

Therefore $\quad$ Minor conjugate $= 6 + \dfrac{6}{.75} = 14$ inches

and

Minor conjugate $= 6 + \dfrac{6}{.28} = 27.4$ inches approximately

Therefore, the light source will move between 14 and 27.4 inches behind the condensers.

These calculations are rough but are close enough for designing. Always plan for a few more inches than your calculations show are necessary.

(d) *Movement of the Light Source*

In an enlarging system, the light source must be located on the optical axis of the condensing and enlarging lens system. This is achieved by allowing for an up and down and side to side adjustment of the light source. This adjustment should be 10% of the diameter of the condensers on either side of the optical axis.

(e) *Placement of Negative with Respect to Condensers*

Plan the negative holder so that the negative will be as close to the condensers as is practical. Most enlargers

hold the negative between ¼ to ½ inch from the condensers.

(f) *Condenser Mounts*

Condensers are plano-convex lenses. They are mounted with the convex sides facing each other and almost touching. The mounting bracket for condensers is inexpensive and can be purchased from any photographic supply house. It is much better to purchase this bracket than to attempt mounting the condensers yourself.

(g) *Amount of Diffusion in System*

The enlarger should be planned so that light bulbs can easily be changed. Diffusion can be secured by replacing a clear bulb with a frosted one. A removable piece of ground or opal glass should be placed about eight inches in front of the light source as well. Designing your enlarger this way gives an easy choice of no diffusion, slight diffusion and great diffusion of the light source.

A PHOTOMETER FOR PAPER EXPOSURES

Just as the procedures of negative making can be standardized to insure the production of quality negatives, so the procedures of printing can be standardized and made extremely simple.

In printing it is doubtful if more than one out of a hundred photographers expose test strips on every negative to determine the exact exposure time. All photographers will agree it is an excellent idea but few have the patience to do it. An experienced worker becomes quite good at estimating exposure times from the light on the enlarging easel but always spoils a few sheets of paper now and then.

Just making test exposures will not always insure good prints. negative and paper scales must be matched as well. Over a period of time many packages of paper are wasted and it is all quite unnecessary. There is a very simple method by which the exposure time and paper scale can be found for any negative, for any degree of enlargement, in about five seconds.

If a measure of light is known to produce the first gray tone off white on the printing paper, and the actual amount of light coming through the corresponding negative tone can be measured, a comparison will quickly give the actual exposure time for the print.

Figure 70

The Photometer in Use.

A photometer can be easily constructed which will accurately make this comparison and give correct exposure times for any paper. The photometer (Fig. 70) will also give a reading of the scale of any negative so that paper scales and the negative scales can be properly matched. It is but a few seconds work to take these readings, and far less time and trouble than test exposures. In two weeks it will save its cost in paper. There will be no more bad guesses and prints of far better quality will be turned out.

The photometer consists of three parts: a comparison box containing a block of white chalk, a standard light source which is a three-volt flashlight bulb, and a graduated scale. The comparison box is attached to one end of the scale and the standard light moves along the scale. (Fig. 71.)

The scale is made from a piece of maple $22\frac{1}{2}''$ x $1\frac{1}{4}''$. The comparison step is a piece of chalk $\frac{3}{4}''$ x $1\frac{1}{4}''$ x $\frac{3}{4}''$. A block of french

chalk is secured from a drug store and a piece this size is cut out with a scroll saw and sanded smooth. This block is glued across the end of the scale.

The comparison box is made from thin sheet metal or heavy white mounting board. Cardboard is the easiest material to use and is entirely satisfactory. The sides of the box are 1½″ x 1¾″. The back is 1¼″ x 1¾″. The top and front are 1½″ x 1¼″. Cut a ⅜″ hole in the center of both the top and the front. Cut half of a ½″ hole in the front end of the top piece and the top end of the front piece. Glue the box together, paint it black inside and out, then glue it over the comparison step on the scale.

The housing for the standard light is made from thin sheet metal. The sides are 1¾″ x 2″, the back and front at 1½″ x 1¼″, the top is 1¼″ x 2″. The box is soldered together so that the sides project down, guiding the housing as it is moved across the scale.

A ⅛″ hole is made in the center of the front of the housing and three strips of thin cardboard ½″ x ¾″ are glued around the hole. Three more strips the same size are glued over them so that the edges project over the other strips. This makes a pocket in which to place a small piece of old film to cut the intensity of the light source when calibrating it.

A lamp socket for a three-volt flashlight bulb is obtained from a toy automobile and soldered to a piece of 1/16″ brass 1¼″ x ½″. A metal strip 1½″ x ½″ is bent into an L so that the base of the L measures ⅝″. The brass strip holding the lamp socket is drilled and tapped for a ⅛″ threaded bolt 1½″ long. This bolt goes through the back of the housing, holds the lamp fixture in place and rests in a hole in the L-shaped strip. The holes in the housing, the lamp fixture and the L-shaped strip are drilled at the exact height to place the filament of the lamp ¾″ high, on the line of the hole in the front of the housing.

A hole for several feet of lamp cord is drilled in the back of the housing, the L-shaped strip is soldered in place and the housing is painted aluminum inside and black outside. When assembled the housing should move freely along the scale. The lamp cord is connected to a switch and two dry cells connected in series. Paste a small piece of tissue paper inside the lamp housing over the hole on the front to evenly diffuse the light from the bulb.

Construction of Photometer

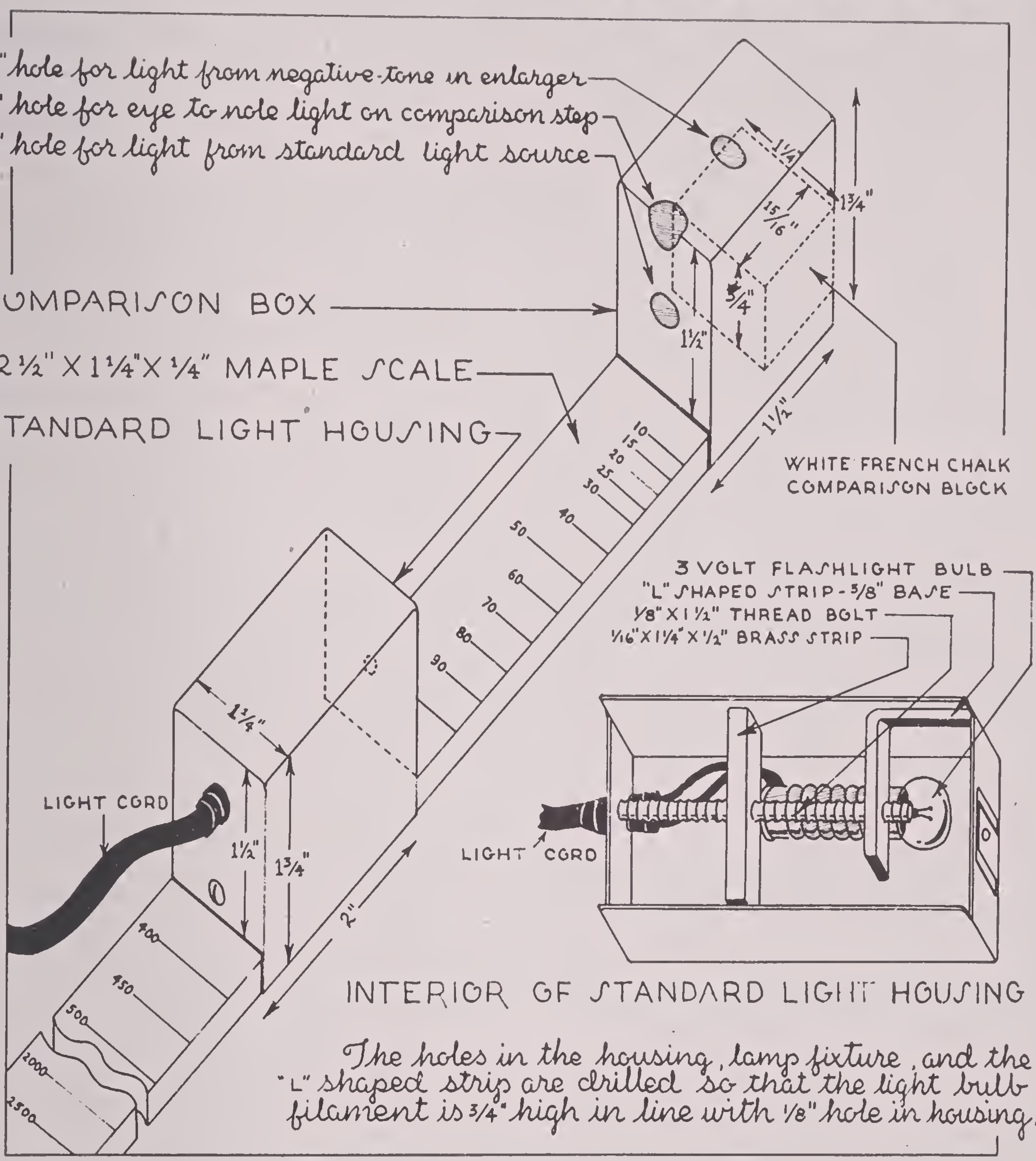

Figure 71

The scale is marked off in exposure units measuring from the front of the white chalk comparison block. Exposure units are the square of the distance in centimeters from the comparison block. The following measurements are sufficiently accurate for laying out the scale in terms of exposure units. Measure off the distance and mark in lines and figures with india ink.

SCALE FOR EXPOSURE UNITS*

Exp. Units	*Inches*	*Exp. Units*	*Inches*	*Exp. Units*	*Inches*
5	$\frac{7}{8}$	160	$5\frac{1}{16}$	625	10
10	$1\frac{1}{4}$	170	$5\frac{3}{16}$	650	$10\frac{3}{16}$
15	$1\frac{9}{16}$	180	$5\frac{3}{8}$	675	$10\frac{3}{8}$
20	$1\frac{3}{4}$	190	$5\frac{1}{2}$	700	$10\frac{9}{16}$
25	2	200	$5\frac{11}{16}$	750	$10\frac{15}{16}$
30	$2\frac{3}{16}$	210	$5\frac{13}{16}$	800	$11\frac{5}{16}$
35	$2\frac{3}{8}$	220	$5\frac{15}{16}$	850	$11\frac{11}{16}$
40	$2\frac{1}{2}$	230	$6\frac{1}{16}$	900	12
45	$2\frac{11}{16}$	240	$6\frac{3}{16}$	950	$12\frac{5}{16}$
50	$2\frac{13}{16}$	260	$6\frac{7}{16}$	1000	$12\frac{5}{8}$
55	$2\frac{15}{16}$	280	$6\frac{11}{16}$	1100	$13\frac{1}{4}$
60	$3\frac{1}{16}$	300	$6\frac{15}{16}$	1200	$13\frac{7}{8}$
65	$3\frac{1}{4}$	320	$7\frac{1}{8}$	1300	$14\frac{7}{16}$
70	$3\frac{5}{16}$	340	$7\frac{3}{8}$	1400	15
75	$3\frac{7}{16}$	360	$7\frac{9}{16}$	1500	$15\frac{1}{2}$
80	$3\frac{9}{16}$	380	$7\frac{3}{4}$	1600	16
85	$3\frac{11}{16}$	400	8	1700	$16\frac{1}{2}$
90	$3\frac{13}{16}$	425	$8\frac{1}{4}$	1800	17
95	$3\frac{7}{8}$	450	$8\frac{1}{2}$	1900	$17\frac{7}{16}$
100	4	475	$8\frac{11}{16}$	2000	$17\frac{7}{8}$
110	$4\frac{3}{16}$	500	$8\frac{15}{16}$	2100	$18\frac{5}{16}$
120	$4\frac{3}{8}$	525	$9\frac{3}{16}$	2200	$18\frac{3}{4}$
130	$4\frac{5}{8}$	550	$9\frac{3}{8}$	2300	$19\frac{3}{16}$
140	$4\frac{3}{4}$	575	$9\frac{9}{16}$	2400	$19\frac{9}{16}$
150	$4\frac{7}{8}$	600	$9\frac{13}{16}$	2500	20

CALIBRATION OF THE PHOTOMETER

Determine the highlight exposure time for a Vitava Opal paper according to pages 150 to 153. Use the speed rating of 8 for that paper and multiply the number of seconds for the highlight exposure by 8.

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* "Perfect Print Control"—Laurence Dutton.

The speed rating of 8 for Vitava Opal paper is an arbitrary number assigned to that paper for convenience. This paper varies little in speed over many batches and is the most convenient standard to use. Any other number could be used as well as 8. However, 8 is convenient and neither too large nor too small. Therefore, the photometer system described here takes the speed of Vitava Opal as 8 as standard and compares all other paper speeds to it.

For example, suppose the highlight exposure is found to be 20 seconds. $20 \times 8 = 160$.

Therefore, the enlarger light has a value of 160 units. Set the photometer light at 160 on the scale and match the lights on the comparison step by placing a bit of old negative in the pocket on the front of the lamp housing. Try different bits of negative densities until the two lights match fairly well. Complete the calibration by turning the screw controlling the lamp itself.

When the flashlight bulb burns out recalibration is always necessary. It is well to use fresh paper for calibration and recalibration. Over a period of time dry cells gradually lose their energy and it is advisable to renew the dry cells every six months, whether they appear to be weak or not.

Once the standard light has been calibrated it is set for about six months. The light may not burn out even at that time. However, in the interests of accuracy both dry cells and bulb should be renewed in that time. Calibration sounds complicated but actually takes no more than three or four minutes.

For those who wish to purchase a Photometer the M. C. M. Photometer manufactured by the Haynes Products Company, Inc., New York, N. Y., will be found satisfactory. This works on a regular lighting circuit. Fluctuation of line voltage is a serious problem in some industrial communities with wide load variations at different times of the day. This is sufficient to cause variations in photometer readings. For this reason the constructed photometer using large dry cells and a flash light bulb gives more constant results than a photometer working off the regular lighting circuit.

EXPERIMENTS

(1) With a condenser type enlarger and a negative made

according to standard procedure, make three enlargements:

(a) With a clear projection bulb and no diffusion.

(b) With a frosted projection bulb and no other diffusion.

(c) With a frosted projection bulb and a ground glass for diffusion in front of the condenser.

Make the prints on the same grade of paper and compare them for tone separation.

Read the effective negative density scales with the photometer. Are the statements on page 135 correct?

(2) If you have access to a diffused light source enlarger which does not have condensers, but only opal or ground glass diffusers, make the best possible print of a negative containing some printed matter or other extremely fine detail. Make another print with a condenser enlarger on the same paper. How much longer was the exposure time with diffused illumination? Get the best possible print in each case and compare the definition.

Chapter Ten

PRINTING PAPER CHARACTERISTICS

Some years ago I took some prints to Julien Levy* and asked him for frank criticism. After carefully going over them he turned to me and said, "If you are ever going anywhere in photography, you must first learn to print a picture. Go back and make these prints over and over again until you make good ones." It was excellent advice. Making the negative is just half the job; getting the most out of the negative is the other half.

Many photographers go through life without wasting time on test strips when enlarging. If the print comes up too fast it is taken out quickly. If it comes up slowly, development is forced. This quite definitely is not the way to get results in printing.

Even the usual test strips of a series of exposures of an important part of the picture only partially give the key to perfect prints. These test strips give the exposure time for full development but do not match the negative and the paper scales.

A photometer with complete instructions for its use in printing has been included in this book because it is the only way in which to get the best print from every negative. Its use is faster than test strips and much less bothersome. True, when a new batch of paper is purchased, several tests are made to determine its characteristics. This, however, takes no more than five minutes. The use of the

* **Julien Levy Galleries.**

photometer will amply repay any photographer in time alone to say nothing of the paper that will be saved and the quality of the prints that will result.

The most important factor in printing is to have a negative of proper quality. If the tones are not separated on the negative, they never will be in the print. If the density is not suitable for the method of printing, good prints cannot be made. If the tones are not registered properly by exposure, no amount of manipulation in printing will correct them. It is impossible to make good prints without good negatives.

Assuming the proper negative, the factors affecting the quality of the prints are:

1. Selection of printing paper so the density scale of the negative and the exposure scale of the paper are matched.
2. Accurate exposure to place all tones in the paper exposure scale.
3. Full development.

Before perfect prints can be made papers must be tested for their speed and their exposure scales. Knowing the speed will give the key to correct exposure with full development; knowing the exposure scale, will give the maximum tone rendition from every negative. This is far removed from guessing, as so many photographers are in the habit of doing.

PRINTING PAPERS

Printing papers are available in a wide variety of surfaces, speeds, and contrasts. Surfaces can be seen in sample books at the photographic supply houses. There is no way, however, of comparing speeds and contrasts except in a very broad general classification. Bromide papers are fast, chlorobromides not so fast, and chlorides slow. How fast or how slow is a matter of question. Soft papers have longer exposure scales than normal papers and normal papers have longer exposure scales than contrast papers. One manufacturer uses normal, medium, and contrast to describe exposure scales. Another uses soft, normal and hard. About all one can really be sure of, without testing, is that all manufacturers' hard or contrast grades are short scale papers. How short or how long is again a matter of question.

Testing papers for their exposure scales and speed values is not difficult and the tests are performed in a few minutes. The actual number of papers used by any photographer is not very many and if each one is tested for speed and exposure scale, many wasted sheets will be saved. The most important point is, however, that print quality will always be obtained without guesswork.

The meaning of the exposure scale of a printing paper commonly referred to as paper scale should be clearly in mind. It does not refer to the number of possible variations of grey tones visible to the eye between black and white. It is only a measurement of the ratio of exposure required to produce a white tone and a black tone. All papers of the same surface texture will show the same number of grey tones between black and white but they can have widely different exposure scales. One paper may need 10 times the highlight exposure to produce black. Another may need 100 times the same exposure.

The meaning of subject scale is the ratio between the brightest part and darkest part of the subject. Here it is a direct measurement of the light reflected from these parts of the subject.

Negative density scale has a similar meaning. It is a measurement of ratio of opacity to light of the densest negative tone and the clearest negative tone. Paper exposure scale has a different meaning for it is the ratio of exposure between black and white, not the actual tones of the paper. Negatives have exposure scales as well as density scales.

The tone scale of the subject is translated into the tone scale of the negative (density scale) and this acts as a series of different exposure steps which are transmitted to the paper. The subject tone scale and negative density scale are determined primarily by the subject matter. The exposure scale of a printing paper as well as the exposure scale of a negative is determined in manufacturing and has nothing to do with the subject. It is obvious that the exposure scale of printing paper must match the density scale of a negative for reproduction of all the negative tones.

TESTING PAPER SPEEDS

Paper testing requires a standard light source. The enlarger furnishes it. Raise the enlarger as high as it will go, and without a negative in the carrier, stop the lens down to the smallest stop and throw the lens out of focus.

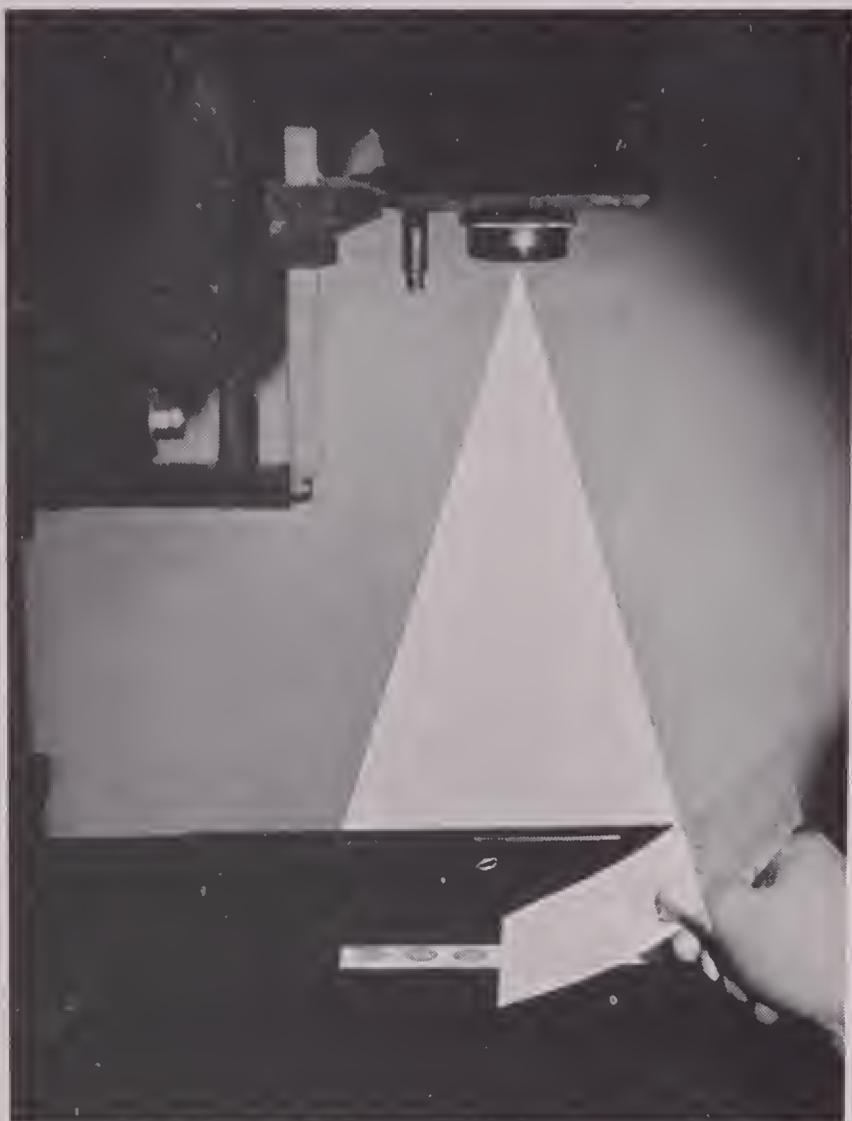

Figure 72

Finding Highlight Exposure Time.

Cut a strip of paper to be tested about 1″ x 6″ and place six coins on it. With a piece of cardboard as a shield, give exposures of 1 2 4 8 16 32 seconds, testing for the exposure that will give the first highlight tone off white. Expose the test strip for one second and shield the first coin; after two seconds shield the second coin; after four seconds shield the third coin, etc. (Fig. 72.)

Develop the test strip in the print developer used as standard. Be sure the temperature and potassium bromide content are always the same and that fresh developer solutions are used.

Some standard paper developer formulas are given in Chapter Eleven. It makes little difference what formula is used for paper development as long as the following points are observed:

(1) Paper tests must be made with the developer which will be used in printing. Varying developers will vary paper speeds all over the map.

Figure 73. First Test for Highlight Exposure Time.

(2) Paper tests and printing must be made with the developer at the same temperature or paper speeds will vary. It is well to use 70° F. as the standard working temperature. Be sure to take the temperature of the developer after dilution.

(3) Always use fresh developer for all paper tests.

(4) Always use the same amount of potassium bromide in the developer in both testing and printing.

If the first test exposure shows nothing on development, give more exposure by opening the lens one stop and try again. The strip should look like Figure 73.

The first highlight tone off white is the first distinctly recognizable different tone from the paper base. It is very important to determine this tone accurately as it is the measure of the speed of the paper. In Figure 73 three steps are visible. Counting backwards 32, 16, 8, the highlight exposure appears in eight seconds.

A second text exposure is now made to determine exactly where this highlight comes in. Is it 8 or 7 or 6 seconds? This time these exposures are chosen:

3 4 5 6 7 8 seconds

Knowing about where the tone is coming from the first test exposure, the second exposures are made in units of 1 second to pick up the highlight tones as accurately as possible. When the highlight exposure time has been determined, a reading of the enlarger light is taken with the photometer.

$$\text{Speed rating of paper} = \frac{\text{Reading of photometer for first highlight tone}}{\text{Number of seconds for first highlight tone}}$$

If the first test exposure shows a highlight tone in 2 seconds, as the highlight tone cannot be determined accurately in fractions of 2 seconds, the lens in the enlarger is stopped down to cut the amount of light used. Closing the lens one stop halves the amount of light, so one stop will bring the highlight tone in at 4 seconds. Closing another stop will bring it in around 8 seconds. Here the highlight tone can be accurately determined.

It is not always convenient to see lens stops in the dark room so the enlarger light is usually adjusted by the photometer.

In this case the highlight tone is wanted in 8 seconds instead of 2 seconds. This means ¼ the light should be used. Therefore, a reading is taken of the enlarger light; multiplied by 4, and the enlarger light adjusted.

For example, if the enlarger light reads 50 and it is multiplied by 4 the photometer is set at 200 and the lens stopped down until the two lights compare on the comparison step.

In this book the speed rating of a paper is the number of photometer units for the first highlight tone in one second. Paper speeds vary with different surfaces of the same brand, with different contrasts of the same brand, with age, and with batches. Readings will also vary with the photometer, the value chosen for the first highlight tone and the type of enlarger.

The importance of paper testing is not to match some set of arbitrary readings but to have a series of comparisons made by yourself with your own instrument under your regular working conditions. The following speeds are merely guides. They are not to be used without checking. They are selected at random from a number of papers to illustrate the differences in speed ratings. A glance at this table and the importance of making these tests becomes apparent. Your own results will not be exactly the same.

Paper	*Speed Rating*
Kodabrom E—No. 1 Normal	150
No. 2 Medium	100
No. 3 Contrast	50
No. 4 Extra-Contrast	45
Kodabrom G—No. 2 Medium	100

Portrait Proofing		7½
Vitava Projection	No. F 2 Normal	37
	No. F 3 Contrast	17
Vitava Opal C		8
Defender Velour Black	C Normal	90
	C Contrast	40
	I Normal	100
	I Contrast	30
	F Normal	75
Ilford Plastika	F2K Normal	100
	B2K Normal	150
Brovira	7051 Soft	300
Kodalure M		10
Kodalure R		13
Illustrators Special		13

The paper speed, once determined, should be marked on the envelope of the package. As new batches of paper are used the speed should be rechecked.

Having the definite measurement of the amount of light necessary to produce the first highlight tone on the paper, if the photographer can measure the amount of light coming through the exact negative tone to print as the first highlight tone, he obviously has the key to correct exposure. In practice this is exactly what is done. The negative tone is measured on the photometer and this reading divided by the paper speed gives the correct exposure time. The height of the enlarger, degree of enlargement, lens stop, or light source are of no moment. A direct comparison of the light coming through a particular negative tone and the known amount of light necessary to give the first highlight tone is made. This, however, is part of the next chapter.

DETERMINING PAPER EXPOSURE SCALES

A negative in the enlarger projects a series of different light intensities onto the printing paper. The exposure scale of a paper is the range of light intensities it will record. There is a minimum exposure required for the first highlight tone and a maximum exposure for the deepest shadow tone. The exposure scale is found by dividing the highlight exposure into the shadow exposure. If 1 second is the highlight exposure and 100 seconds is the shadow exposure, the exposure scale is 1-100.

Figure 74

Finding the Exposure Scale.

The exposure scale of a paper has nothing to do with the number of black to white tones the paper will produce. This is a physical characteristic depending on the surface of the paper. Matte papers show about 70 recognizable greys between black and white; semi-matte papers about 100 greys and glossy papers as high as 150 greys, regardless of their contrast. The difference in contrast of printing papers of the same surface is not in the number of usable tones but in the exposure times required to produce them.

The exposure scale of a paper is easy to determine after the paper speed is known, particularly when the paper speed rating is the number of photometer light units required for the first highlight tone in one second. The photometer light is set at the speed rating of the paper. Without a negative in the carrier the enlarger light is stopped down until it equals the photometer light. Knowing the first highlight tone comes with one second exposure, additional exposures are made until the blackest black of the paper is produced.

To determine the exposure scale, a piece of cardboard 2″ x 6″

Figure 75. Test for Exposure Scale.

is cut and ruled with lines ½″ apart, numbered from 1 to 10. This guide is placed over the edge of the strip of paper to be tested which is cut 1¼″ x 6″. A second piece of cardboard cut 4″ x 6½″ is used as a mask. Figure 74 shows the set-up under the enlarger ready to make the test. As the seconds are counted off the mask is slid upwards, covering the exposed part of the paper. The guide lines show how far the mask for each exposure should be moved.

The following series of exposures are suggested for trial:

Step	*Contrast*	*Normal*	*Soft*	*Extra Soft*
1	10 Seconds	20 Seconds	30 Seconds	90 Seconds
2	12	24	38	106
3	14	28	46	122
4	16	32	54	138
5	18	36	62	154
6	20	40	70	170
7	22	44	78	186
8	24	48	86	202
9	26	52	94	218
10	40	80	130	300

Figure 75 shows such a step exposure test. The maximum black is easy to see at step No. 6 for no further blackening takes place. Step No. 6 for normal paper is 40 seconds. As the first highlight tone is 1 second and the blackest tone is 40 seconds the scale is 1-40. As papers get softer more exposure is used between steps so that each step produces a noticeable darkening in tone. If gradual shading is produced the maximum black is hard to find.

On the tenth step of every test it is well to give a prolonged exposure as a check to be sure the maximum black is reached.

If the paper does not reach its total blackness with one series of exposures, another series is tried until the blackest black is definitely

located. Some contrast papers may reach their blackness in 10 seconds; others require 30 seconds. Normal papers must take from 30 to 90 seconds and soft papers may require 300 seconds.

As in testing for the speed of the paper, the standard developer is used, carefully watching the temperature, the bromide content and using fresh solutions. The exposure scale of the paper is written on the envelope along with the speed factor.

The exposure scales of a few papers are listed below. These characteristics will vary widely and are only a guide.

Paper	*Exposure Scale*
Kodabrom E—No. 1 Soft	1 to 52
No. 2 Medium	1 to 40
No. 3 Contrast	1 to 16
No. 4 Extra Contrast	1 to 10
Kodabrom G—No. 2 Medium	1 to 48
Portrait Proofing	1 to 54
Vitava Projection—F 2 Normal	1 to 32
F 3 Contrast	1 to 24
Vitava Opal C	1 to 26
Defender Velour Black—C Normal	1 to 32
C Contrast	1 to 18
I Normal	1 to 24
I Contrast	1 to 20
F Normal	1 to 40
Ilford Plastika—F2K	1 to 122
B2K	1 to 186
Brovira 7051—Soft	1 to 106
Kodalure M	1 to 28
Kodalure R	1 to 16
Illustrators Special	1 to 36

By selecting exposure times as suggested on page 155 much time can be saved. In making the tests on a normal paper, the steps are 4 seconds apart, on soft papers 8 seconds apart and on extra soft papers 16 seconds apart. To speed up a test on soft paper, if paper with speed value of 100 is to be tested, the enlarger light instead of being set at 100 is set at 100 divided by 8, or 12½. Exposure steps formerly 8 seconds apart are made in 1 second intervals and the entire test strip is made in 10 seconds instead of taking a minute and a quarter.

In timing exposures keep a loud-ticking clock near at hand and count one thousand and one, one thousand and two, one thousand and three, etc., for each second, and check by glancing at the clock before and after making the test exposure.

EXPERIMENTS

(1) Take the speed ratings of all papers on hand.
(2) Take the exposure scales of all papers on hand.

DETERMINING PAPER SCALES WITH A STEP WEDGE

Another method for testing paper scales is to procure a step wedge such as manufactured by The Photo-Lab Products Company.* This wedge is a negative with a series of 19 steps each 1.5 denser than the previous step.

To use it, cut a piece of paper its size and place under the enlarger without a negative in the carrier and with the lens wide open. Give five seconds exposure and develop in fresh paper developer at the standard temperature for the standard time and with the standard amount of potassium bromide.

When dry count the number of distinct steps visible. The wedge steps are 1, 1.5, 2, 3, 4, 6, 8, 12, 16, 24, 32, 48, etc., each step 1.5 times the previous one. If nine steps are visible, count nine steps on the margin of the wedge, and the ratio is 1-16. If 12 steps are visible, counting 12 steps would give a ratio of 1-48.

The advantage of this method is that the exposure of the wedge can vary widely and only the exact number of steps of the paper will print. Of course if the steps border on either the top or bottom of the wedge another test should be run with a different exposure time so you are sure you have caught each end of the scale.

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Chapter Eleven

ROUTINE PRINTING

PROOFING

An intermediate step between the negative and the print, often omitted in the anxiety to finish the picture, is proofing; yet it is an essential step in a good photographer's routine. With experience photographers do learn to read negatives but even the best photographers do not willingly rely on this. A proof, no matter how rough, shows far more than any visual examination.

The only reason for not proofing all negatives is the time involved. With the method to be suggested it is assumed that the proofs are for the photographer's own personal study and will not be shown to anyone else. The procedure is very fast and a hundred $3\frac{1}{4} \times 4\frac{1}{4}$ negatives can be proofed in fifteen minutes.

An ordinary contact printer (Fig. 9) has its light cut down using one 25-watt bulb and 4 or more sheets of tissue paper in addition to a ground glass. Even more tissue paper may be necessary. The light is adjusted so a flash exposure of a negative to a fast chlorobromide paper such as Velour Black or Eastman Projection will develop in D-72 in 45 seconds to one minute.

D-72

	Avoirdupois		Metric
Water (125° F.)	16	ounces	500.0 cc.
Elon	45	grains	3.1 grams
Sodium Sulphite	1½	ounces	45.0 grams
Hydroquinone	175	grains	12.0 grams
Sodium Carbonate	2¼	ounces	67.5 grams
Potassium Bromide	27	grains	1.9 grams
Water to make	32	ounces	1.0 liter

For use, take stock solution 1 part, water 4 parts.

Sheets of enlarging paper are cut down to the negative size and the negatives are given a flash exposure, one after the other as fast as one can operate. After all the proofs are exposed, they are placed individually in the developer. About 8 prints can be developed at the same time. They are then fixed washed and dried. Proofing, admitted photographic drudgery, can be amazingly simplified in this fashion.

DIFFICULTIES IN ENLARGING

To achieve quality in printing, the print must always come up to the proper depth of tone within the limits of the correct developing time and then hover around this correct depth of tone without much change. The exposure must be gauged to bring this about with full development. Papers are coated with a thin layer of emulsion and development must always be carried to completion. Anything short of this time gives feeble prints.

If the exposure has been too long, the print will darken rapidly in the developer. To prevent its going too dark a photographer will often snatch it out before development goes to completion. This causes mealy greys and poor gradation instead of rich blacks and full gradation.

If the exposure is too short, the print will not darken sufficiently. The darks will be grey, not black, and there will be insufficient tone separation in the highlights. Forcing, or leaving the print in the developer for a longer period of time than normal sometimes works if the exposure has not been too short, but forcing often degrades the highlights by fogging and veiling. The length of the time of devel-

Figure 76
Over-Scale Print—Too Contrasty.

Figure 77
Short-Scale Print—Exposed for Highlights. Too Flat.

opment cannot be made to compensate for large errors in exposure.

Another common cause of poor print quality is the failure to match the density scale of the negative and the exposure scale of the paper. A negative in the enlarger carrier becomes an exposure wedge, and the range of light values transmitted by the negative is the range of exposures for the paper. If the exposure scale of a paper is 1-40, it requires 40 times the light for the first highlight tone to give the maximum black tone. Obviously for a full-scale print on this paper a negative with an effective density scale of 1-40 should be used. Then the first highlight tone in the print will correspond to the densest tone of the negative and the maximum black will correspond to the clearest tone of the negative. When the density scale of the negative and the exposure scale of the paper match perfectly a full scale print results.

If the effective density scale of the negative is greater than the exposure scale of the paper, an over-scale print results. This drops tones from both highlights and shadows as it cannot register the full range of negative exposures. Such a print is made by printing a negative with a density scale of 1-40 on paper with an exposure scale

Figure 78.
Short-Scale Print—
Exposed for Shadows—
Too Flat.

of 1-15. (Fig. 76.) The scales are so far apart a good print cannot be made.

If the density scale of the negative is far less than the exposure scale of the paper, the full range of the paper is not used and a short scale print is produced. Such a print would be made printing a negative with a density scale of 1-10 on paper with an exposure scale of 1-128. If just the highlight tones are used, Figure 77 results. More exposure to get a darker print produces Figure 78. A good print cannot be made.

For satisfactory prints the effective density scale of the negative and the exposure scale of the paper must be approximately the same.

DEVELOPERS AND DEVELOPMENT

Each manufacturer recommends a developer for his particular brand of paper. As no photographer ever sticks to one brand of paper, a darkroom is soon cluttered with numerous different paper developers. The following developers are suggested for standard use, not because they are any better than any other developers but simply as a matter of convenience.

In paper developers the potassium bromide content controls both the speed and the tone. The more bromide, the slower the developer and the warmer the tone. Speed ratings of papers are only useful if

the same developer and same bromide content used in testing are used in printing. Good prints are not made using a different developer every printing session. Always use the same formula, accurately diluting it, accurately measuring the potassium bromide content, and accurately measuring the temperature. It is important to watch these factors with whatever developer is used so that standard working conditions are approached every time.

The following warm tone developing formula is recommended because it permits some variation in contrast with chlorobromide papers using different dilutions:

D-64 METOL HYDROQUINONE PRINT DEVELOPER

Stock Solution No. 1	*Avoirdupois*	*Metric*
Water at 125° F.	16 ounces	500.0 cc.
Metol	68 grains	4.7 grams
Sodium Sulphite	1 oz. 55 grains	33.8 grams
Hydroquinone	75 grains	5.2 grams
Sodium Carbonate	385 grains	26.9 grams
Potassium Bromide	35 grains	2.4 grams
Water to make	32 ounces	1.0 liter

Stock Solution No. 2		
Water at 125° F.	16 ounces	500.0 cc.
Sodium Sulphite	1 oz. 55 grains	33.8 grams
Hydroquinone	275 grains	19.2 grams
Sodium Carbonate	385 grains	26.9 grams
Potassium Bromide	35 grains	2.4 grams
Water to make	32 ounces	1.0 liter

For use dilute as follows:

A — Contrast —	No. 1	6 ounces (180 cc.)
	No. 2	12 ounces (360 cc.)
	Water	14 ounces (420 cc.)
B — Medium —	No. 1	6 ounces (180 cc.)
	No. 2	6 ounces (180 cc.)
	Water	20 ounces (600 cc.)
C — Soft —	No. 1	12 ounces (360 cc.)
	Water	20 ounces (600 cc.)

To each 32 ounces (1 liter) of diluted developed add 1 dram (4 cc.) of 10% Potassium Bromide solution.

This developer contains a minimum amount of potassium bromide. For warmer tones more bromide should be added.

The variation in contrast obtainable with this developer on chlorobromide papers from the A to C dilution is not as much as a change in one grade of paper. However, it is useful at times.

With bromide papers and where the cold black tone of amidol is preferred the following formula containing potassium metabisulphite is recommended. The potassium metabisulphite content prevents stained fingers unless the solution is over-worked.

AMIDOL PRINT DEVELOPER

	Avoirdupois	*Metric*
Water	16 ounces	500.0 cc.
Sodium Sulphite	320 grains	21.0 grams
Amidol	60 grains	4.0 grams
Potassium Metabisulphite	15 grains	1.0 grams
10% Potassium Bromide	15 drops	15 drops

It is interesting to know that this amidol formula works at the same speed as the D-64 dilution B so that the paper speeds worked out with one are good for the other.

Most manufacturers recommend develoment to take place in 1½ minutes and it is best to expose for this time. The appearance of the print is judged after 1½ minutes to determine whether a little forcing is necessary. Chlorobromide papers can be left in the developer two or three times this period without harmful results. This is not true with regular bromide papers. Even though a presumably good safe light is used in the darkroom, the developing tray should be covered with a large sheet of cardboard to prevent fogging.

If for some reason good results are not obtained with the above formulas, use the manufacturer's recommendation.

After development, the print should always be rinsed in a stop bath to prevent yellow stains after fixing.

ACID RINSE BATH

	Avoirdupois	*Metric*
Water	32 ounces	1 liter
Acetic Acid, 28%	1½ ounces	48 cc.

(To make 28% acetic acid from glacial acetic acid, add eight parts of water to three parts of acid.)

After the acid rinse bath, the paper is placed in a fixing bath. The following stock solution makes a convenient way of keeping hypo.

STOCK HYPO SOLUTION 50%

	Avoirdupois	*Metric*
Hypo	4 pounds	2000 grams
Hot Water to	1 gallon	4 liters

STOCK HARDENER SOLUTION

	Avoirdupois	*Metric*
Water	20 ounces	640 cc.
Sodium Sulphite	4 ounces	120 grams
Acetic Acid 28%	12 ounces	360 cc.
Potassium Alum	4 ounces	120 grams

(To make 28% acetic acid add 8 parts of water to 3 parts of glacial acetic acid.)

PLAIN HYPO BATH

50% Stock Hypo	2 parts
Water	3 parts

Satisfactory with Amidol developers.

ACID FIXING BATH

	Avoirdupois	*Metric*
50% Stock Hypo	6 ounces	200 cc.
Water	10 ounces	300 cc.
Potassium Metabisulphite	¼ ounce	7 grams

For use with M-Q Developers.

ACID FIXING-HARDENING BATH

50% Stock Hypo	4 Parts
Water	4 Parts
Stock Hardener	1 Part

For use when hardening is required. Prints which will be etched with a razor blade in finishing should always be fixed in this bath.

Do not keep used hypo baths. Hypo is cheap. Throw it away after using.

ESTIMATING EXPOSURE

Print quality depends on full development, correct exposure, and matching the negative and paper scales. By selecting a minimum

development of $1\frac{1}{2}$ minutes full development is insured. The correct exposure is then determined fitting this developing time. It can be determined in three ways:

1. Guessing
2. Test exposure strips
3. With the photometer

Guessing, of course, is the way it is usually done. With experience the exposure time is estimated from the appearance of the image on the enlarging easel. But even the most experienced printers lose a good deal of paper this way. Guessing at the exposure time usually amounts to making a test exposure with a full sheet of paper.

Test exposures, when made, are on a small strip of paper which is placed in an important area of the picture. Usually one-half the estimated exposure is given and 1/3 of the strip is shielded. Then the middle third gets the estimated exposure and is in turn shielded, and the last third gets double the estimated exposure. The strip is developed for $1\frac{1}{2}$ minutes, fixed, and examined in white light. The correct exposure time is then gauged from it.

However, the easiest way to determine exposure is with the photometer. With the negative in place, focused and ready to print, a reading is taken of the densest tone on the negative. This prints as the first tone off white on the paper.

$$\begin{array}{c}\text{Exposure time}\\ \text{in seconds}\end{array} = \frac{\text{Reading of densest negative tone}}{\text{Speed value of the paper}}$$

What could be simpler? To get the exposure time divide the photometer reading of the densest negative tone by the speed value of the paper. The speed value is the amount of light necessary to register the first highlight tone in one second. The reading of the photometer is the amount of light available for the first highlight tone. So, dividing them gives the number of seconds for the correct exposure. It is very simple and very practical.

In printing the Frontispiece the densest portion is the highlight on the rim of the eye glass. This measured 200 on the photometer. The Illustrators Special paper used for the print had a speed of 12 so an exposure of 17 seconds was given.

The only place to go wrong with photometer measurements is in

selecting as a point of measurement parts of the negative which are meaningless in the print. In a portrait against a white background, use some part of the figure for the highlight measurement, not the background. The background should print as white, not a tone off white. In landscape with bald skies, they too should print white. At the other end of the scale determine where the black is to come and measure at that point. It is not necessarily the clearest tone on the negative. Measurements must be made from where you decide to print the first tone off white and the blackest black tone.

Photometer measurements in printing do not make perfect prints an automatic procedure. That is too much to expect. Even the best workers will print 5 to 10 times to get a perfect print. Photometers make good prints easier but perfect prints will still require remaking, study and perseverance. The photometer is a device to save paper; it will not make perfect prints for you without your own judgment being used.

MATCHING THE NEGATIVE AND THE PAPER

If one has the photometer, it is very easy to match the negative density scale and the paper exposure scale. If one does not have the photometer it is not easy and much a matter of trials, errors and bad guesses. It is also hard on the disposition.

Assuming the photographer has the photometer, readings are taken of the thinnest and the densest portions of the negative. In the Frontispiece the densest portion is the highlight along the bridge of the nose. This measured 200. The thinnest portion is the shadow under the chin. This measured 10. So the effective density scale is 1-20.

(This measurement was made in an enlarger with an opal glass photo flood bulb and condensers. Using a T-20 400-watt photo blue bulb and condensers, the effective density scale measured 1-35. Using a completely diffused light source the effective density scale measured only 1-10. It is obvious what can be done by changing the light source in the enlarger.)

For best tone separation the light source giving the largest density scale should be used. In this case a much better print will be made using an effective negative scale of 1-35 than the scale 1-10.

In matching the effective negative scale and the exposure scale of the paper it must be borne in mind that tones are the result of geometric progressions.

Geometric Progression of Tones	1	2	4	8	16	32	64	128
Number of Steps		1	2	3	4	5	6	7

Thus a negative with an effective density scale of 1-35 will give good prints on papers whose exposure scales are more than 1-35. The quality of the print will not be affected until the paper scale is in the province of the next step in the progression: in this case 1-64. Thus all papers with scales of 1-35 to 1-50 will give good prints. In practice it is well to select paper with an exposure scale slightly greater than the negative scale.

In printing the negative of Alexander Woollcott for the Frontispiece, the negative scale was 1-35 and the paper exposure scale 1-52. In printing the negative (Fig. 5) the effective negative scale was 1-10 and the paper exposure scale 1-14.

ESTIMATING EXPOSURE TIME AND SCALE WITHOUT A PHOTOMETER

There is one method of testing that can be used if the photometer is not constructed, which will give better results than the usual test exposure methods and is superior to just guessing.

Examine the image on the enlarging easel and pick out the densest spot in which detail is required. Then pick out the thinnest spot which should not print absolutely black. With these two points in mind cut a strip of test paper 1½″ wide which is long enough to include both spots. Fold the strip along the length, emulsion side out, and expose for an estimated length of time, making sure both spots are on the test strip.

Then the strip is turned over and a second exposure is given. If the negative is normal or thin, give 25% less exposure. If the negative is heavy, give 25% more exposure.

Develop for the standard time in the standard developer and fix. Then judge the test strip. Never judge any tests before fixing.

If the test strip is far out of the way, a second strip should be

tried. Having the right exposure for the highlights, the contrast of the paper can be judged by looking at the shadows. If they have gone black, the paper scale is too short and a softer paper is called for. If the shadows are too grey, a shorter scaled paper is called for.

This is the best method of trial and error testing that has yet been suggested. It is far better than just guessing but it is still a much harder way of getting perfect prints than using the photometer.

EXPERIMENTS

(1) From the same negative make two straight prints, one in amidol and one in the normal Metol-Hydroquinone developer given. Compare for color.

(2) Determine the difference in highlight exposure time for the same paper in the amidol developer, the A B & C dilutions of the regular developer, and the B dilution with five times the amount of 10% potassium bromide. This will give you the compensating factors for exposure with any of these developers.

(3) From the same negative make two straight prints, one developed in the normal Metol-Hydroquinone developer and the other with five times the amount of 10% potassium bromide solution added to the developer. Compare for color.

(4) Take a normal negative which gives a good print on normal paper. Print this negative on contrast paper and print it on soft paper. Compare all prints. Make some further exposures on the hard and soft papers to see if a good print can be made on either of them.

What is the effect of a normal negative printed on contrast paper?

What is the effect of a normal negative printed on soft paper?

(5) Take a normal negative and make a good print on normal bromide paper carrying development for two minutes. Make a second print using 2 x the exposure and ½ development time. Make a third print using 4 x the exposure and ¼ development time. When all three prints are dry compare them.

(6) Take a normal negative and make a normal print on bromide paper carrying development for 1½ minutes. Make a second print using ½ the exposure and 2 x development time. Make a third print using ¼ the exposure and 4 x development time. When all prints are dry compare them.

Chapter Twelve

THE FINER POINTS OF PRINTING

There is one law in photographic printing which every photographer learns from experience. Good prints cannot be made from poor negatives. Some good negatives, however, are improved by control of one kind or another. Control does not necessarily mean overcoming the defects of poor pictures by the intrusion of hand work, as in paper negative or bromoil procedure. Control is applicable to a straight photograph, without violating photographic principles. Used properly it further emphasizes or subdues the tone relationships photographed originally. There are six ways in which control can be used.

1. Changing the denisty of negative tones by chemical intensification or reduction.
2. Changing the apparent negative scale by varying light source in the enlarger.
3. Changing the appearance of the print by using papers with different exposure scales.
4. Changing the appearance of the print by modifying the developer, or using reducers or intensifiers.
5. Local control in printing.
6. Local holding back of negative areas by the application of dyes.

CONTROL OF NEGATIVE TONES WITH CHEMICALS

Intensifiers and reducers are made for photographers who do not know how to make good negatives. If a photographer knows how to

"Jane" Paul Louis Hexter, A.R.P.S.

Figure 79. High Key Print.

make a good negative he does not need intensifiers or reducers. If he does not, then they are of little help because he cannot make good pictures anyway. A thoroughly experienced photographer finds them at best uncertain. Fine salon pictures are not made from chemically treated negatives and this method of control should not be considered. The negatives should be properly made in the first place.

CONTROL THROUGH ILLUMINATION

The control possible through changing the source of illumination in the enlarger has been discussed in Chapters 9 and 11. When photographers dilute paper developers and manipulate formulas, they are attempting to change the exposure scale of the printing paper. Far more can be accomplished by changing the source of light behind the negative than can be accomplished with the manipulation of developers.

CONTROL BY VARYING PAPER EXPOSURE SCALES

Routine printing calls for the production of full scale prints where negative density scales and paper exposure scales are almost alike. This gives a brilliant full rendering. Not all pictures should be presented this way and over-scale as well as under-scale prints have their place.

The over-scale print is the brilliant advertising print that is being used today by some of the leading photographic illustrators. The exposure scale of the paper is purposely selected so it is less than the negative. Figure 58 is a print made this way. The negative scaled 1-60 and the paper scaled 1-36. The exposure was measured from the densest negative tone wanted on the paper, not the actual densest negative tone.

The brilliant over-scale print is the best rendering for such a picture. It is definitely out of place in a portrait as in Figure 76. Here the print of Alexander Woollcott is definitely a bad job.

Short-scale prints are the opposite of over-scale prints. Here the exposure scale of the paper is selected so it is far greater than the negative density scale. A true high-key print is made this way. (Fig. 79.) Here the effective density scale of the negative is 1-6 and the paper is selected with an exposure scale of 1-70. Referring to the geometric progression on page 167, 1-6 uses three steps in the progression where the paper will record six steps. By placing the first

"Cajon Pass" *Paul Louis Hexter, A.R.P.S.*

Figure 80. Low Key Print.

tone of the negative on the highlight tone of the paper, the shadow tone of the negative will only be a medium grey. Three steps of the progression are used out of a possible six.*

As paper scales seldom go much beyond 1-150, it becomes apparent why short scale high-key prints cannot be made from negatives with large effective density scale ratios. For high-key work the paper scale must be in the neighborhood of the square of the negative density scale, not just double it.

Low-key prints are short-scale prints just as are high-key prints except they are printed at the low end of the scale. In Figure 80 the negative was projected from a diffusion enlarger so it scaled 1-10 and printed on a paper scaling 1-70, a true low-key print.

The exposure of a low-key print is determined by measuring the thinnest portion of the negative. Divide by the speed factor as usual,

* True high-key negatives can be made only of subjects with very light tones, photographed on very soft working portrait film.

then multiply by the exposure scale to put this tone down to blackest black.

In portraits and outdoor scenes with large sky areas, exposure is, as a rule, better measured from the most important tone area of the negative rather than the highest light. Thus in the Frontispiece the exposure should be based on placing the face tones half way down the paper scale rather than getting the highlight on the glasses just off white. The face area is the important part of the picture. Similarly in Figure 52 the exposure is based on the clouds as a middle tone for there is not a true highlight in the picture and full scale is definitely not wanted. The first highlight tone off white can be used as a measurement only when it is important to the print.

CONTROL BY MODIFYING THE DEVELOPER

The actual exposure scale of a printing paper cannot be altered greatly by changing the developer formulas, by the use of forebaths,* or by chemical manipulations. The change in scale using a contrast developer and a soft developer is not as great as the change in one grade of paper.

An apparent change, however, can be made by preventing strong blacks. This is the reason a diluted developer makes a print appear softer. A greater effect of softness can be secured by adding ⅛ grain of potassium iodide to each working ounce of developer (13 cc. of a 1% solution to each 500 cc. of developer).

A soft developer formula that is useful is:

STRAIGHT METOL DEVELOPER

	Avoirdupois		*Metric*
Water	20	ounces	1000 cc.
Metol	55	grains	6 grams
Sodium Sulphite	1	ounce	45 grams
Sodium Carbonate	¾	ounce	33 grams
Potassium Bromide	30	grains	3 grams

Dilute 1 part with 3 parts water for use.

With the use of the photometer and a knowledge of paper characteristics, these methods will not have much use because much more control can be exercised in other ways.

* Sterry Process.

The indiscriminate use of potassium bromide in developing formulas, without accurate measurement is not conducive to best results. Potassium bromide controls the tone of the print. The more bromide, the warmer the tone; the less bromide, the colder the tone. Potassium bromide also controls the speed of the developer and each change in bromide concentration means a corresponding change in exposure time. Potassium bromide has little effect on the exposure scale. The apparent increase in contrast from additional bromide is caused by a slowing down of development time with loss of detail in the light parts of the print. If a correspondingly longer development period is used there is no change in contrast.

There are, however, two other ways of changing the scale which are manipulations worth using. One is to develop in a diluted straight metol developer for the highlights, switching to a standard M-Q developer for the shadows as soon as detail comes in the highlights.

The other method is a modification of the Person process. Soak the enlarging paper in the developer for two minutes, sponge it off, and then make the exposure regulating the timing so the full exposure takes from 2½ to 3 minutes. The shadows develop out under the enlarger, preventing further exposure to those areas. At the same time highlights receive their full quota of light, thus altering the scale. This is a very useful process but requires some experimenting to properly balance the length of exposure with the developer.

Prints can be intensified and their color improved by the following procedure:

Stock Solution A	10% Potassium Bichromate
Stock Solution B	10% Hydrochloric Acid

For use take

Solution A	20 parts
Solution B	40 parts
Water	100 parts

After washing, bleach in this bath. Rinse in a 5% sodium carbonate solution and wash until free from yellow discoloration. Redevelop in amidol without bromide and wash.

Prints can be reduced with the following procedure:

		Avoirdupois	Metric
(a)	Common salt 25% sol.	3 drs.	10 cc.
	Sulphuric Acid 10% sol.	2 drs.	6 cc.
	Water to	20 ozs.	500 cc.
(b)	Potassium Permanganate 5% sol.	3 drs.	10 cc.
	Water to	20 ozs.	500 cc.

Mix A and B just before use. Immerse the wet print. If reduction is not carried far enough when the solution discolors, discard and use fresh solutions.

Clear by bathing in 1% potassium metabisulphite or sodium sulphite solution and wash.

LOCAL CONTROL DURING PRINTING

For shading, dodging, and holding back areas during printing, the following accessories are required: an aperture board and a long hat pin. The aperture board is a piece of cardboard larger than the size of the print, with a two-inch hole cut out slightly off the center. To darken small areas during printing use the thumb and one or two fingers in the hole of the aperture board to make a small opening of the required shape and give additional exposure. Keep the board in motion all the time.

Knowing the number of seconds required for the first highlight exposure on the paper, it is easy to estimate the additional time required to darken any area.

To darken areas at the edge of the print without exposure of the center areas (the Frontispiece is slightly shaded this way), the fist is clenched and kept over the center of the print and the arm moved back and forth in a sweeping movement. (Fig. 81.) The fist keeps the center area from being exposed and the swing of the arm keeps the areas of the print shadowed by the arm from being too completely shadowed. Gradually raising the fist will graduate the darkening toward the edges of the print.

To lighten small areas on the print, a tuft of cotton is stuck on the tip of a long hat pin and the required areas are shaded during exposure. The hat pin is kept in constant motion.

The effectiveness of almost any print is greatly enhanced by a judicious use of control to darken light areas and lighten shadow areas. In this way the center of interest of the picture is set off and

Figure 81

Shading in a Print.

tone areas are blended one into the other. Checker board patterns of lights and darks are softened and brilliant white areas which trap the eye are toned down. Skillful technique in this part of the photographic process is of great help to an artist who chooses photography as the medium in which to work.

Some prints are also improved by distortion or elongation which is accomplished by (1) tilting the negative carrier, (2) tilting the printing paper holder, or (3) supporting the printing paper in such a way that it does not lie flat. The lens is stopped down sufficiently to print the negative sharply. Architectural subjects are straightened by (1) and (2). Distortion can be used to give added meaning to a picture (Fig. 82) or it can produce comical images like the curved mirrors in an amusement park (Fig. 83).

Controlled prints are not a matter of one or two tries and then success. Sometimes skillful workers make as many as 20 prints to achieve maximum effectiveness. A great deal of patience, a good supply of paper, and a knowledge of effective picture presentation

are the essentials for the successful use of control in projection printing.*

LOCAL CONTROL BY DYE STAINING

If large negative areas must be held back, it is easier to stain them red with new coccine than to attempt to hold them back by shading.

NEW COCCINE STOCK SOLUTIONS

Dissolve one gram (15 grains) of new coccine in 100 cc. (1 ounce) of distilled water. Make the following dilutions:

	Stock Solution	*Distilled Water*
No. 1	25 cc. (1/4 ounce)	300 cc. (3 ounces)
No. 2	25 cc. (1/4 ounce)	150 cc. (1 1/2 ounces)
No. 3	25 cc. (1/4 ounce)	75 cc. (3/4 ounces)
No. 4	25 cc. (1/4 ounce)	....

The dye is applied in small quantities with a No. 2 water color brush starting with the lightest stock solution and using more concentrated solutions until the areas are sufficiently stained to hold them back. A few trials will show what can be expected from the color. When the negative does not seem to take more dye, allow it to dry for two minutes and proceed again. Always work slowly for a gradual staining.

Excess dye should never remain on the negative surface and can be wiped off with a tuft of cotton. New coccine should be applied so gradually that no outline of the dye appears in the print. The appearance of an outline is caused by using the concentrated dye solution too quickly. If a mistake is made, the dye can be washed out of the negative.

LOCAL CONTROL WITH ETCHADINE

Etchadine** is a patented composition for local reduction. It is quite useful in removing or lightening unwanted large areas of blacks on prints which would be difficult to attack in routine finishing. The Etchadine control medium is spread over the surface of the either wet or dry print with a wad of cotton. After a minute, light applica-

* The technique of printing control is only briefly indicated here. For full details see New Projection Control, by William Mortensen, price $2.75.

** Manufactured by Jamieson Products Company, Redondo Beach, Calif.

"The Mendicant" Paul Louis Hexter, A.R.P.S.

Figure 82. Distorted Print. Figure 65 is a straight print.

tions of the reducing solution appropriately thinned are made. The amount of thinning determines the speed and degree of reduction. When staining takes place the paper is swabbed with the control medium. Using Etchadine involves the successive application of medium, reducer and more medium. The print must be refixed and washed.

EXPERIMENTS

(1) Make a straight print of a portrait negative. Make a second print giving an all-over exposure of one-half the required time, and with the aperture board shade in the hair accents to the full time, the face alone for an additional one-quarter of the time, making three-quarter exposure on the face. Then give an additional quarter exposure to the eyes, mouth, and contour, breaking the contour line rather than making the increase in exposure continuous all over it. Give any additional exposure to cheeks, chin and forehead, or ears, required for emphasis or toning down after an examination of the straight print.

Shading of this nature is not the simplest manipulation in the world. Properly done it is so gradual and delicate it cannot be perceived yet it immeasurably adds to the effectiveness of every picture by giving additional emphasis to the accents. Such control will not make a bad picture good but it will make a good picture better because of greater emphasis on important areas.

(2) Take a portrait negative which has been made against a white background and give it the required exposure. Remove the negative carrier and stop the enlarger lens down to its smallest stops. With the fist over the already exposed areas and the arm moving from side to side, shade in the corners of the picture, but not to the extent of giving a halo around the head. The darkening of the corners keeps the picture in the frame and can be used to some extent in almost any picture.

To estimate how many seconds to shade in the background, measure the amount of light coming through the enlarger with the negative removed and the lens stopped

"Egoist Image" *Paul Louis Hexter, A.R.P.S.*

Figure 83. Distorted Print.

down all the way. Divide the highlight exposure factor of the paper into it and you have the time required for the first tone off white. Judgment will tell you how much to increase this exposure to reach the desired grey tone.

Chapter Thirteen

FINISHING, MOUNTING AND FRAMING

Photographers unable to achieve true photographic quality in their work have resorted to manual retouching of the negative to correct its shortcomings. Tonal gradation and texture rendition are the absolute properties of the photographic medium and if they are not recorded originally in the negative, hand work will never imitate them.

The very characteristics that make photography a fine expressive medium are entirely overlooked by many photographers. It is no great wonder that people generally fail to admire portraits made with artificial pattern lighting in imitation of Hollywood, a complete lack of emphasis on texture and tone gradation, and much unnecessary retouching.

Such photographers regard the negative as more or less of a tracing of the face on which to perform the operation of retouching. Any semblance of actual texture is immediately obliterated with cross-hatching. Character lines are subdued and often eliminated. Mouths are reshaped, eyes are reset, and noses are remoulded until the resulting portrait, with skin texture as smooth and toneless as a plate of ice cream, bears little resemblance to the actuality of the person who sat for it.

Retouching, or the imitation of photographic quality by hand-work, is unalterably bad. No artist has yet been able to imitate photographic quality regardless of his cleverness. If gradation is not in the original negative, it cannot be put in afterwards synthetically.

Finishing a print is quite different from retouching, for the aim of finishing is to emphasize photographic quality, not to create it. There is no general corrective for poor technique.

Finishing consists of:

(1) Touching all light spots with India ink to match the surrounding area.

(2) Etching all dark spots with a razor blade until they match the surrounding areas.

All matte papers will take India ink. However, all matte papers can not be etched. Papers are tested for suitable etching qualities by abrading the surface with a new razor blade. The gelatine surface must powder easily without pulling or gouging. Use Eastman Opal C to get the feel of it. Many satisfactory papers are manufactured.

Semi-gloss and gloss papers are difficult to finish because etching and spotting without leaving traces is more difficult. Some lint and dirt always show on enlargements of any considerable size even when scrupulous cleanliness is observed and these marks always clean up more easily on matte paper.* In enlarging work, semi-gloss and glossy papers give too much trouble in finishing except for those occasional negatives which have few imperfections.

SPOTTING THE PRINT

The first operation in finishing is spotting with stick India ink applied with a No. 2 water color brush. A palette for India ink is sold at all artists' supply houses. It consists of a smooth slate square hollowed on one surface and a square of ground glass. In spotting light tones where little color is required, the India ink is rubbed on the smooth slate. In spotting dark tones which require more color, the India ink is rubbed on the rougher ground glass.

In working, the brush is touched to the tongue and a small amount of ink is deftly picked from the palette. A trial for color is made on the border of the print and, if correct, the spot is touched in with the brush.

Always work with an almost dry brush, going over the work

* Always clean the glass in your enlarger before using. Use a solution of 85 cc. ethyl alcohol, 10 cc. methyl alcohol, 5 cc. ammonia. Apply with a tuft of cotton and wipe off before dry with a chamois. Then dust with a camel hair brush. This will eliminate much of the dirt on enlarging. This solution can also be used on dirty negatives to remove spots and finger marks.

Figure 84. Print Before Finishing.

several times rather than applying all the color in one touch. The brush should never be wet enough to deposit a globule of water on the surface of the print. Areas larger than pin points should be spotted from the edges inward. After five minutes practice any print can be spotted so that the work cannot be seen even on minute examination. India ink dries without a sheen and matte paper takes the ink perfectly. When spotting semi-gloss or gloss papers, a touch of ordinary mucilage should be added to match the sheen of these papers.

ETCHING THE PRINT

The second operation in finishing a print is etching with a razor blade. The razor blade etch is used for the opposite of spotting, for black spots make their unwanted appearance on prints just as often as white spots. The way to remove them is to scrape them out with the edge of a new Autostrop razor blade. To take the etch, the print must always be bone dry.

Figure 85. Print After Finishing.

The edge of the blade is held lightly between the thumb and forefinger and the black spots are *powdered* away. There is a touch for this work that comes with practice. A dull blade or too heavy touch will gouge the paper and sometimes ruin the print. In small areas the blade is worked toward you and in larger areas the blade is pushed away from you. The razor blade etch is just as important as spotting with India ink.

Figures 84 and 85 illustrate the difference between a straight enlargement with more than the usual number of blemishes and the finished print, spotted and etched. No trace of finishing can be found on the finished print.

Small black areas can be darkened, if necessary, with a Wolfe BB Carbon pencil. Larger dark areas can be given an even tone by blending the pencil work with pumice and cotton. Large white areas cannot be darkened with pencil work and if such darkening is required these areas must be shaded-in at the time of making the print.*

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* For a detailed and illustrated discussion of the technique briefly indicated here see Print Finishing by William Mortensen. $2.50.

MOUNTING

A photograph should never be displayed until it is properly finished and mounted. For mounting stock, smooth triple-weight cream white paper cut to 16″ x 20″ can be purchased reasonably in quantities of 50 or 100 sheets from a wholesale paper house. This mount size is acceptable in all salons and, therefore, should be adopted as standard.

Pictures look best when mounted on a step-off of neutral colored paper, such as Strathmore Charcoal Gray. Black step-offs are sometimes effective with low key prints but are too outstanding for most pictures. The step-off is cut one-eighth of an inch larger all around than the picture and the picture then mounted on it.

The adhesive for mounting is Higgins Vegetable Glue or rubber cement. A very narrow thin film of adhesive on the upper edge of the print is all that is necessary if the picture is placed under glass, otherwise the adhesive should be placed on both top and bottom. The print and step-off are placed under pressure for a few minutes. An old paper press can be used or the weight of several books is sufficient. If too much glue is used the paper may cockle. This will not happen with rubber cement.

To space the print properly on the mount, lay the print along one edge and measure the distance from the outer edge of the print to the far side of the mount. Divide this in half and locate the print this distance from the side of the mount. To space the print properly from top to bottom, place the print at the top of the mount and measure the distance from the bottom of the print to the bottom of the mount. Divide this into thirds and use one-third for the space at the top and two-thirds for the space at the bottom. Off-center mounting should never be used, for it is a frank admission of a picture with insufficient subject matter bidding for attention by peculiar mounting.

FRAMING

Pictures should be kept under glass whenever possible. Grade "A" white picture glass 16″ x 20″ can be purchased inexpensively in standard boxes of 23 pieces from a wholesale glass company. A suitable heavy cardboard for backing is No. 25 chip board which

can be purchased from a wholesale paper house in packages of 25 pieces 32″ x 40″. They will gladly cut it 15 15/16″ x 19 15/16″, which is the proper size for backing glass 16″ x 20″. Having the mounts, the backing board and glass all cut to standard size makes framing easy.

If the framed pictures are to be hung on walls, drill two holes in the backing board before framing the picture and insert metal passe-partout hangers. The small cloth passe-partout hangers will not support the weight of a picture this size. Picture wire joins the passe-partout hangers after the framing is done.

The mounted picture is placed on the backing board, the glass placed over it, and the backing board, mount and glass are clipped together with clothes-pin clips to prevent slipping. With everything in order a piece of passe-partout binding longer than the edge of the glass is torn off the roll. The ends of the passe-partout are temporarily clipped in place on the glass with clothes-pin clips and the passe-partout binding is scored so the proper width will be on the face of the glass.

The strip of passe-partout is removed, placed on a blotter, and dampened with a wet sponge. Office supply houses sell a small stamp wetting sponge in the end of a celluloid tube. This is ideal for passe-partout work. The wet passe-partout binding is placed on the glass and pressed into place, each side in turn.*

If a picture is worthwhile it is worth the time and effort needed to finish, mount and frame under glass. A picture should always be presented in the most effective possible manner. The appearance of a fine print finished and framed should be a source of pride and pleasure.

* For a detailed, illustrated discussion of this mounting and framing technique see Print Finishing, by William Mortensen. $2.50.

CONCLUSION

An effective public address is dependent upon something to say, a vocabulary, and a manner of delivery which commands attention. An effective photograph is dependent upon these same conditions. The vocabulary of photography is the technique, and the manner of delivery is the composition. To have the manner of delivery and the vocabulary without having something to say is like shadow boxing—it is good practice but has no meaning.

The ability to say something is as uncommon in photography as in public speaking. A photograph may be executed with brilliant technique, its composition may be flawless, yet it may receive no more than a passing glance from an observer. There must be more than just technique.

Creative work is not accomplished by the aimless use of technique waiting for some mysterious intuition to call HALT, hoping to arrive at a destination the way to which is not known. On the contrary creative work is accomplished only when a purposeful mind knows its destination and drives straight toward it. Whether in architecture, painting, sculpture, or photography, creative work is the result of purposeful planning. It does not mysteriously happen. To do fine work in any medium the man must know his goal.

We are all entitled to our opinions of what constitutes good photography and there is no quarrel with any photographer—snapshot, press or commercial—who uses the camera for honest factual recording. The quarrel begins when artistic merit is claimed for such work when obviously it is no more than good craftsmanship. There can be no art in factual mechanical reproduction.

The worship of technique for itself caused a painter to remark, "Photography would be a fine thing if it were not for the pictures." Photography is a modern art in a modern age. Its possibilities are uncharted, unexplored and unlimited. It is a new art form with much unknown territory ready to be conquered by adventurous, active minds with knowledge as the one required weapon. The perfection of technique is just the beginning—not the end.

"There are two great rules of life, the one general and the other particular. The first is that every one can, in the end, get what he wants if he only tries. This is the general rule. The particular rule is that every individual is, more or less, an exception to the rule."

Samuel Butler.